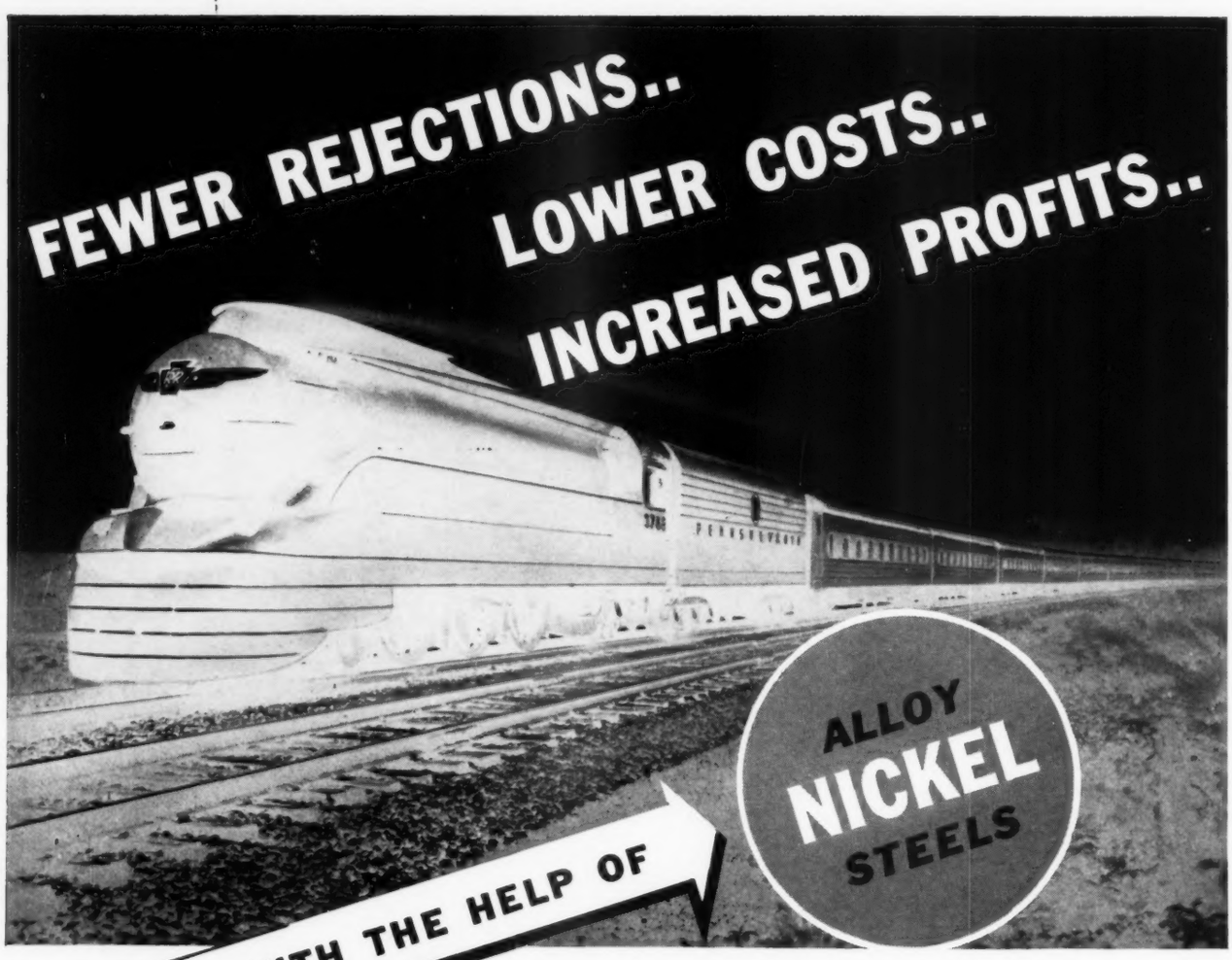
# PRODUCT ENGINEERING

DECEMBER, 1939

# FEWER REJECTIONS.. LOWER COSTS.. INCREASED PROFITS..



..WITH THE HELP OF

ALLOY NICKEL STEELS

*MODERNISM* brings new customers and new profits to railroads. Typical is the "Broadway Limited," leader of the Pennsylvania's fleet of nine new streamliners. From car truck frames of Nickel alloy cast steel to Nickel-copper-molybdenum steel roofs, Nickel saves weight, lengthens service life and pushes down cost per mile and cost per year.

WHETHER you're hauling extra fare passengers, or doing precision machining—Nickel can make each ounce, each inch of metal do more work at lower cost per year.

Nickel, alloyed into steels, irons or non-ferrous metals, provides improved mechanical properties. The heightened abilities of Nickel alloyed materials cut rejects during production, lower machining costs, and increase profits by lengthening service life. For specific information about money-saving applications of Nickel in your industry, please address your inquiry to the address below.

***REJECTIONS CUT 75%***—"Since using Nickel steel (SAE 4615) rejects due to warpage in heat treatment have dropped 75%," says Jacobs Mfg., Co., Hartford. "This Nickel-molybdenum steel provides required hardness and toughness in drill chuck jaws, plus added core strength to prevent bending or breaking. Nickel alloyed chucks *stay* accurate—assure accurate boring and machining."

**THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N.Y.**

# PRODUCT ENGINEERING

**What's Coming**—For more than 40 years, in the design of chain drives the centrifugal force created when a chain goes around the sprocket has been deducted from the allowable chain pull. Centrifugal force also dictated a maximum allowable speed in the neighborhood of 2,000 ft. per min. Now the engineers of the Morse Chain Company announce an entirely new basis for the design of chain drives. By logical analysis, experimental models, laboratory tests and the records of industrial application they have proved conclusively that centrifugal force is not a factor in the design of chain drives and that speeds of about 5,000 ft. per min. are the optimum. The first published complete presentation of this new and far-reaching chain drive analysis will appear in January PRODUCT ENGINEERING.

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**Cover Picture**—Engineering activity at the Studebaker Corporation. R. E. Cole, vice-president in charge of engineering holding a staff consultation with chief engineer W. S. James and the heads of the various engineering divisions.


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# FOR SUPER ACCURATE WORK ON MACHINE TOOL SPINDLES

## BANTAM *Ultra-Precision* BEARINGS EXCEL!

BANTAM is building *Ultra-Precision* Bearings for machine tool spindles so accurately that they operate within half of the tolerance usually accepted for super-precision work. The bearing shown is being regularly supplied to one of our customers. The bore is 7″. Their production charts indicate that combined total eccentricity of bearing and spindle is .0002″ maximum. Face runout, .00015″ maximum. Such precision is obtainable on all types of Bantam Bearings —Straight Roller, Tapered Roller, and Ball.

Leading machine tool manufacturers have chosen BANTAMS because of our ability to supply these bearings at reasonable cost. That's possible because of specialized grinding methods which are standard procedure with BANTAM. Our exclusive process grinds both outside and inside diameters at the same setting, insuring uniform wall thickness, and a degree of concentricity and roundness, heretofore unavailable.

If your bearing requirements call for extreme accuracy, it will pay you to write us for complete information.

**BANTAM BEARINGS CORPORATION**
**South Bend, Indiana**

**Subsidiary of THE TORRINGTON CO. Torrington, Conn.**

TAPERED ROLLER—STRAIGHT ROLLER—BALL
BANTAM
BEARINGS

# To Stimulate the Growth of Ideas

IDEAS are economically worthless until they have been embodied in a material product or social service. But, ironically, the greater the idea is the harder it is to find acceptance for it, though the reverse is not always true. Thus it is that, as repeatedly shown in history, the greatest discoveries went begging or were scorned and ridiculed while South Sea Bubbles, Florida land booms and inflated stock markets flourished. Charlatans often received rich rewards while the spirit of the true scientist and the pioneer inventor was all but crushed.

Ideas cannot be fully appreciated and evaluated except by men of vision because it is only vision than can interpret an idea into an imaginary physical body or an indescribable service value. And in addition, no person can possibly possess the needed vision if he does not have the basic knowledge on which it must be built.

No "visionary" unfamiliar with chemistry could see the possibility of making synthetic rubber out of acetylene. But Du Pont chemists quickly grasped the significance of Father Nieuwland's discoveries. No one without a good understanding of electricity could guess the great possibilities in strong and enduring permanent magnets. But in each of these instances the managements of the companies concerned had great faith in the opinions of their engineers and scientists and, blindly perhaps, generously sponsored the development of those ideas. Therein lies the secret behind the successful developments of new products by big corporations, a formula that can and is being used by large and small companies with equal success.

But blind faith must be preceded by confidence in the judgment, opinions and vision of the men proposing the ideas. This is an essential ingredient for the success of anyone trying to sell anything. But in the case of selling ideas it is practically the one and only sales weapon that counts when trying to induce management to put good money into an idea that to them seems hazy or highly hazardous. And confidence can be built only by successful performance.

Too often the exponent of an excellent idea confines his efforts to preaching its virtues and bewailing the lack of support. His efforts might better be devoted to doing little things here and there successfully and carefully mapping his program of action to finally build to the point where the acceptance of his idea will be merely a matter of course.

On the pages that follow we give an all-too-brief summary of engineering design trends over the past year and show some of the striking design accomplishments. In some of the designs described the detailed steps that lead to the final product are known. And in every instance the final result was from the growth and cultivation of ideas that won support by virtue of confidence in their proposers.

Crashing through with an idea seldom succeeds; the growth and cultivation of ideas is the natural process. Confidence in the man fostering the idea is the essential stimulation for its growth.

# PRODUCT ENGINEERING'S 1939 *Survey of design activity*

## Based on reports from 474 manufacturers

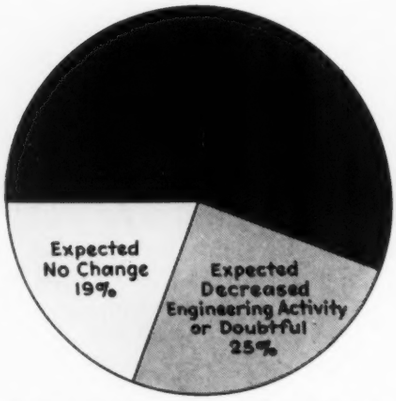
AS SHOWN in the accompanying charts, there has been an increase of about 11½ per cent in the number of designing engineers employed as compared with a year ago, 50 per cent of the reporting companies expect an increase in engineering activity and almost 50 per cent expect a continuance of the present activity while only one manufacturer of the 474 definitely expects a decrease in activity. It can be concluded that the trend in engineering activity as measured by the number of engineers employed will continue upward.

Perhaps the most significant trend reported is the continuing increase in the use of welded construction. More than 25 per cent of the 236 manufacturers of production machinery and transportation equipment reported a definite increase in the use of welded construction. At first glance this figure seemed to be out of line, but a closer study revealed the answer. Improved welding control and technique makes it no longer difficult to make sound welds in alloy steels. This has greatly increased the field for the application of welding, many manufacturers of production and construction machinery now using it for alloy steel assemblies.

Along with the great number of manufacturers reporting new applications for synthetic rubber, about an equal number reported increased attention being given to providing proper seals and gaskets. For example, 14 out of 54 manufacturers of machine tools, 8 out of 30 manufacturers of packaging and food machinery and 6 out of 27 manufacturers of engines and compressors reported an increased use of seals for preventing the escape of oil or the entrance of foreign matter. Many of these engineers reported using seals with a synthetic rubber sealing element and one might conclude that the availability of oil resistant synthetic rubber has encouraged more attention to the sealing problems.

As a sequel to the increased attention given to sealing, many engineers mentioned improvements in provisions for lubrication, such as the adoption of central lubricators

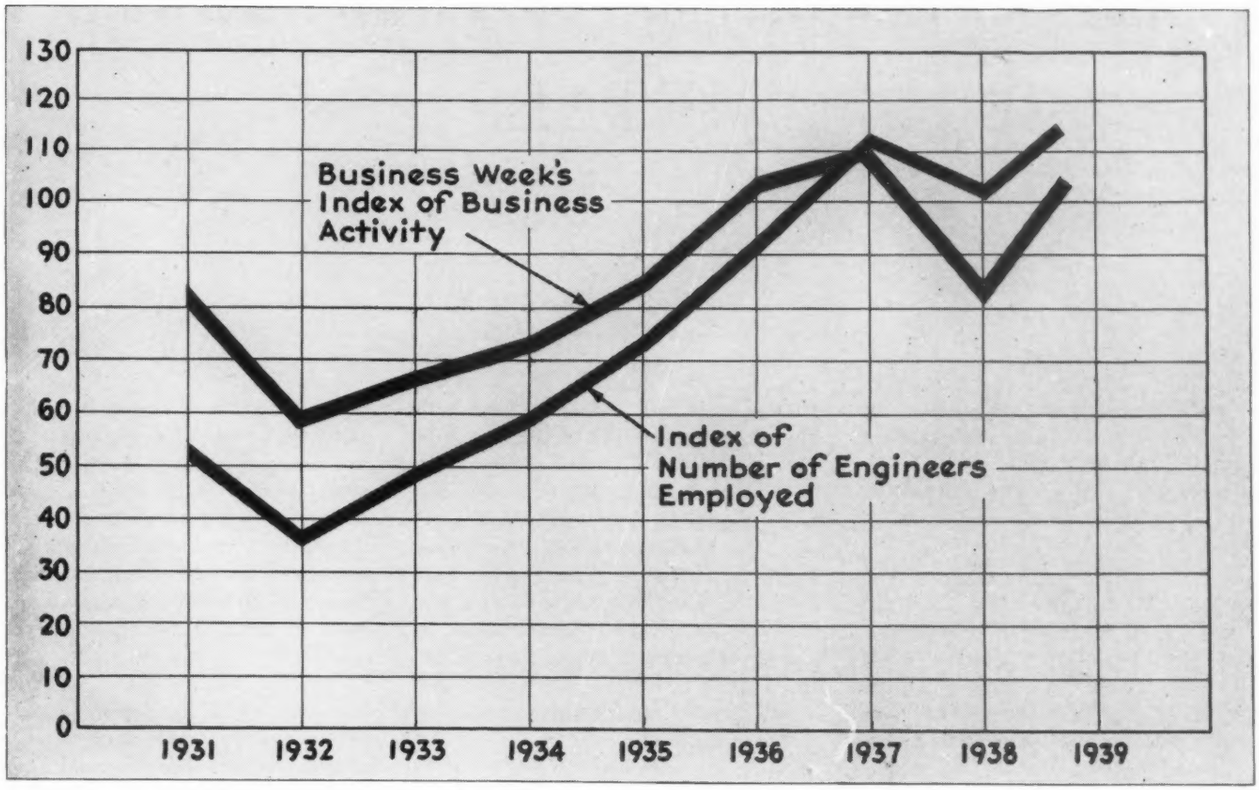
**TRENDS IN ENGINEERING DESIGN ACTIVITY**




*Percentages of plants that reported in the 1938 Survey of Design Activity that they expected more, less, or about the same engineering activity for 1939.*

*The 1938 expectations for 1939 were closely realized as indicated by the relative numbers of plants that increased or decreased staffs since a year ago.*

*In this 1939 Survey only one plant reported an expected decrease in design activity. The others report the same or greater activity expected in 1940.*




with pressure feed to all bearings or a group of bearings, as mentioned by fourteen per cent of a group of manufacturers of machine tools and smaller production machinery.

With reference to materials employed, 20 per cent of the manufacturers of engines and compressors reported an increased use of alloy steels and welding.

Space permits mentioning only certain highly significant items reported on the questionnaires returned. Although 6 out of 34 manufacturers of instruments and smaller devices reported an increased use of zinc and aluminum die castings, the same number reported an increased use of stamped and welded construction. Undoubtedly the tremendous improvements in resistance welding machines over the past few years is now showing its effects as a result of the many new possibilities opened up to the engineer to design parts to be stamped and assembled by resistance welding.

Of interest is the fact that whereas a year ago one manufacturer of lawn mowers attracted a great deal of attention by designing the machine to be made largely out of zinc die castings, this year at least five other manufacturers of lawn mowers have followed suit.

Another significant development is the rapidly increasing use of magnesium alloys to decrease weight, not only in the transportation field and airplanes but also among manufacturers of vacuum cleaners, X-ray equipment, cameras and business machines.

Numerous mentions were made of new uses for photocells and electronic equipment in textile machinery, packaging machinery, food machinery and automatic welders. In line with this these same manufacturers are increasing the use of micro limit switches, electric timers and other automatic controls.

Hydraulics is, of course, being given a great deal of attention. One engineer stated that they were experimenting with the application of a fluid transmission. Also, the chief engineer of a manufacturer of gas engines noted on the questionnaire, "Fluid flywheels are coming into use," referring to the hydraulic type clutches such as now available. Another application of hydraulics is for braking, as reported by a designer of textile machinery.

In the field of finishes the relatively new wrinkle finish seems to be receiving sweeping acceptance in all fields ranging from instruments and home appliances to machine tools. A designer of heaters and ranges reported that the improved porcelain enamel finishes which permit thinner coats have been found far superior to the older fused porcelain finishes in their resistance to cracking and chipping.

On the following pages are given further details concerning the new and improved materials and parts now available to the engineering designer and also numerous examples showing how progressive designers are making use of these parts and materials. For easy reference there will be found on page 4 of this number an itemized index of the improved parts and materials described and examples of their application.

Space restrictions did not permit giving full detailed accounts of the improved materials and parts. To facilitate answering inquiries for further detailed information, each item has been numbered, and readers writing to the editors for further details concerning specific items will please refer to these numbers.

# SOME SIGNIFICANT DEVELOPMENTS IN METALS

Among the significant and most recent developments in metals are those relating to clad metals, aluminum alloys, beryllium copper alloys, silicon-aluminum bronzes, powdered metals and stainless steels.

STAINLESS STEEL CLAD SHEETS are made by placing two sheets of nickel between a sheet of plain carbon or of alloy steel, and a sheet of stainless and welding them together by spot or seam welding. The nickel sheets are required in order to get the proper conditions for resistance welding. (1)

PLATINUM CLAD NICKEL OR COPPER in sheets up to 48 in. by 120 in. of any needed thickness are made by fusing the platinum on the base metal billet and then rolling the combination. Sheets can be platinum clad on one or both sides. Sheets can be formed, punched, welded or soldered. Strip, tubing and wire made from the materials are produced in all commercial sizes and gages. (2)

ALUMINUM COATED STEEL, now available in narrow strips, is well along the path toward commercial availability in wide sheets. This material should find immediate acceptance by cooking and heating appliance manufacturers. Aluminum coated steel has practically as good resistance to temperature as has "17" stainless and can be given finishes available for straight aluminum. (3)

BERYLLIUM COPPER ALLOYS have been found to have a flatter hardness curve when cobalt is added, which also reinforces the hardening effect of beryllium. Small cobalt additions widen the temperature range and lengthen the time at which the material will age-harden. One alloy containing between 0.2 and 0.5 cobalt, available in tubing form, is being used for Bourdon springs. (4)

SILICON ALUMINUM BRONZE that weighs about 14 per cent less than copper is now obtainable in rod and ingot form with hardness values of 140 to 170 Brinell in cold drawn rod, 120 to 150 Brinell in annealed rod, 100 to 130 Brinell in hot forgings, and 80 to 110 Brinell in sand castings. Tensile strengths run from 65,000 to 100,000 lb. per sq. in. This alloy is corrosion resistant to dilute acids, sea water, and many liquids used in process industries; it is also free-cutting. The alloy is essentially hot-working and is not suitable for operations involving severe cold working. (5)

TELLURIUM COPPER patented alloys are now available in tube and rod form. Resistant to corrosion, season cracking, stress corrosion cracking and fire cracking. One type containing about 0.5 per cent tellurium is easy to hot work or forge in a broad range of temperatures from 1,200 to 1,600 deg. F.; can be cold worked, machines freely. Addition of 1.00 per cent nickel and 0.2 per cent phosphorus gives a heat-treatable alloy with yield strengths up to about 40,000 lb. per sq. in. and from about 50 to 90 Rockwell F hardness. (6)

ZIRCONIUM COPPER, a new material for improving standard brasses and bronzes, is now available in the form of a concentrate. Two standard concentrations of high purity, containing 12½ per cent and 35 per cent zirconium are produced by the Hydrimet process, the concentrations alloy immediately with a melt. Zirconium not only acts as a deoxidizer and scavenger of a melt, but when alloyed with manganese bronzes, aluminum bronzes and others, it gives increased hardness and tensile strength, higher thermal and electrical conductivity, and improved corrosion resistance. (7)

METAL POWDERS are used for numerous mechanical parts, including ball retainer rings of pressed powdered bronze, bronze filters for filtering oil on diesel engines, copper base alloys for disk clutch plates, and irregular shapes expensive to machine. One manufacturer is making a grinding wheel with abrasive pressed into a wheel made of powdered aluminum. Another uses gears of pressed powder so that lubrication for the gear bearing on a fixed spindle is provided by seepage of the oil through the gear and thus on to the bearing. Progress has been made in methods for compacting steel powders. (8)

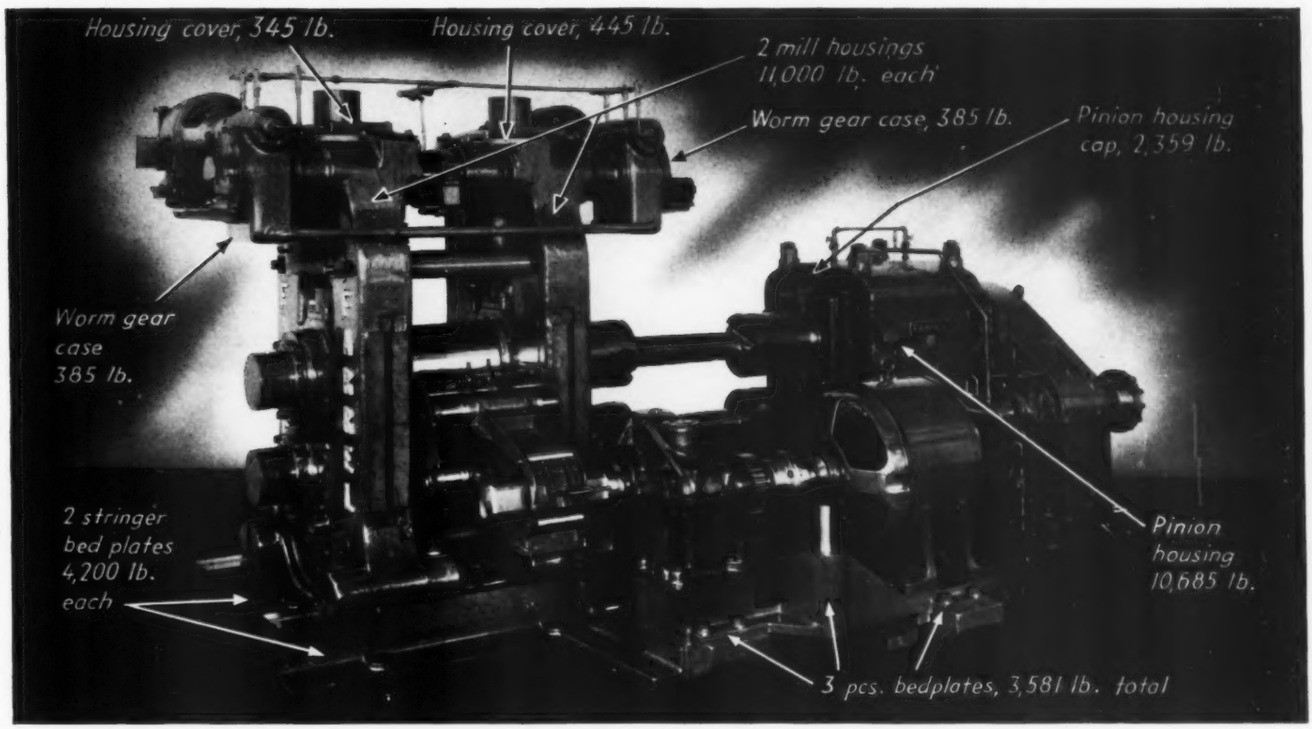
STAINLESS STEEL developments and improvements reported are: Numerous patents issued to The Chemical Foundation for alloys or treatments which are claimed to increase the resistance of stainless steel to pitting; among these are alloying with silver, vacuum annealing and treatment in an acid bath containg $TiC_l$. Considerable attention has been paid to the use of low carbon precipitation hardening alloy where high hardness and corrosion resistance are desired; better machinability of the stainless steels has been actively studied during the year to widen application of stainless to machined parts. (9)

SILICON BRASS DIE-CASTING alloy has been developed for which excellent physical properties and low melting range are claimed. The alloy contains 83 per cent copper, 5 per cent silicon, 10 per cent zinc, 1 per cent manganese, and 1 per cent aluminum. The alloy can also be sand cast. (10)

MOLYBDENUM in greater amounts is being added to stainless steels, usually with an accompanying drop in the percentage of chromium and nickel. This improves the resistance of the steel to mineral and organic acid attack, and enables the steel to remain hard when reheated. (11)

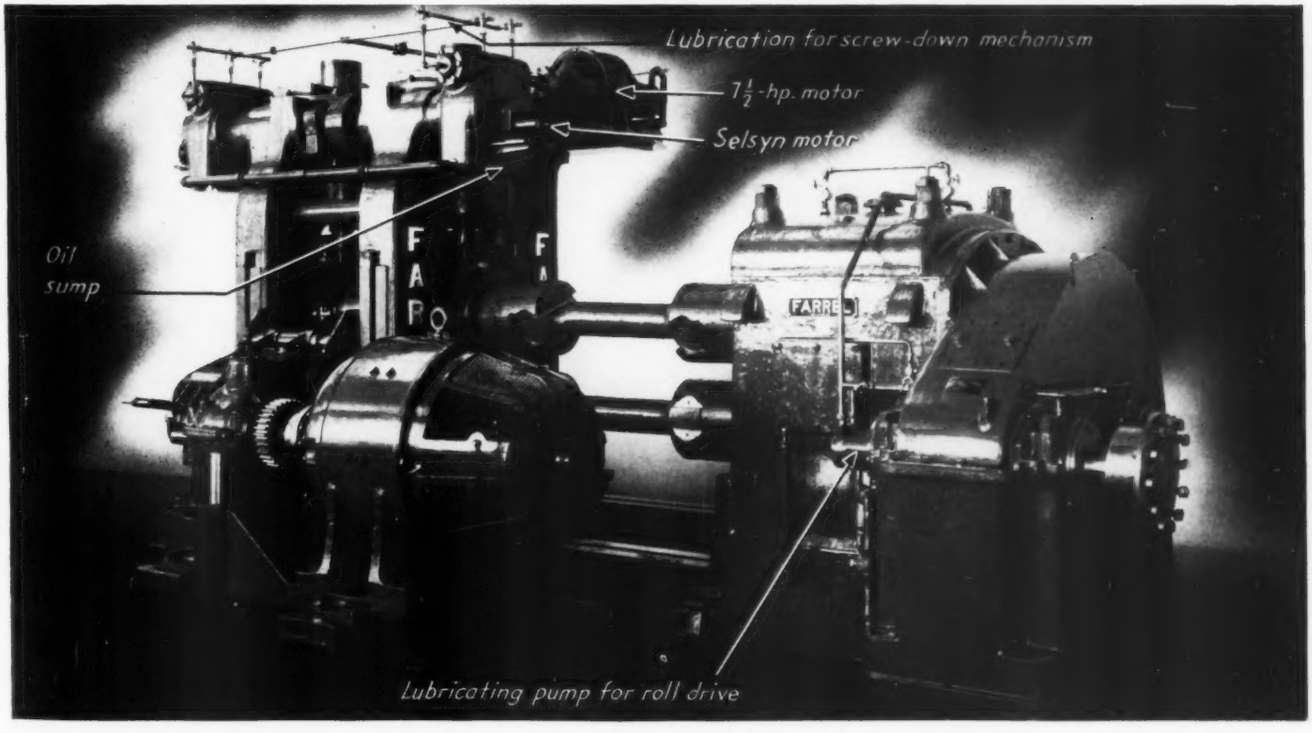
This résumé includes merely the most recent developments. Numerous improvements have been made in previously existing alloys and metals, many of these being referred to in the following pages. See page 4 for itemized index.

# Alloy Iron Castings In High Speed Rolling Mill


Housing cover, 345 lb.
Housing cover, 445 lb.
2 mill housings 11,000 lb. each
Worm gear case, 385 lb.
Pinion housing cap, 2,359 lb.
Worm gear case 385 lb.
2 stringer bed plates 4,200 lb. each
Pinion housing 10,685 lb.
3 pcs. bedplates, 3,581 lb. total

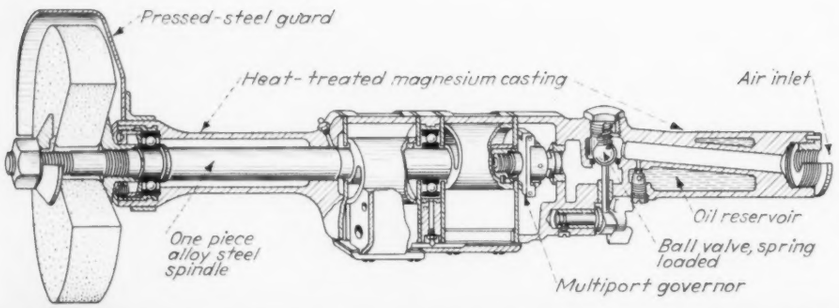
**Over 28 tons** of Meehanite castings are in the housings and bed plates of the Farrel-Birmingham high speed brass mill for rolling strip at 750 ft. per min. The feature of Meehanite is that it possesses the desired combination of strength, toughness and density in both thick and thin sections.

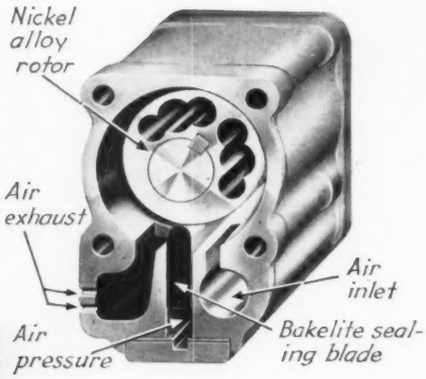
The two screw-downs, each powered with 7½ hp. Reliance motors permit individual adjustment for each screw or simultaneous equal adjustment of both by driving through a connecting shaft and Dings magnetic clutch. Selsyn controlled remote indicators show amount of adjustment to 0.0001 in. Morgoil bearings, separately and continuously flood-lubricated, support alloy iron rolls.

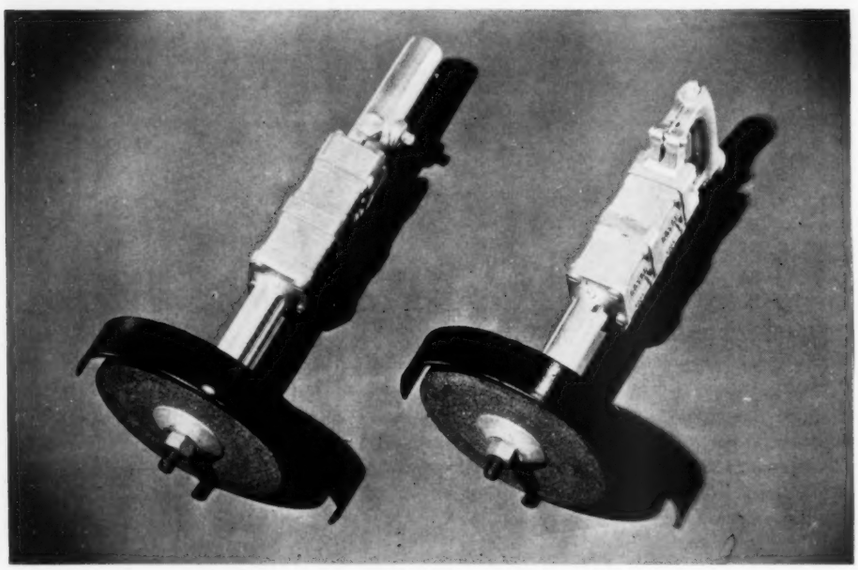



**Built-in oil pump** furnishes spray lubrication to reduction gear drive and flood lubrication of bearings. Screw-down mechanism is lubricated by a separate closed system utilizing a 3 gal. per min. Tuthill pump which is driven by a ½ hp. motor.

# Heat-Treated Magnesium Castings in Portable Grinder

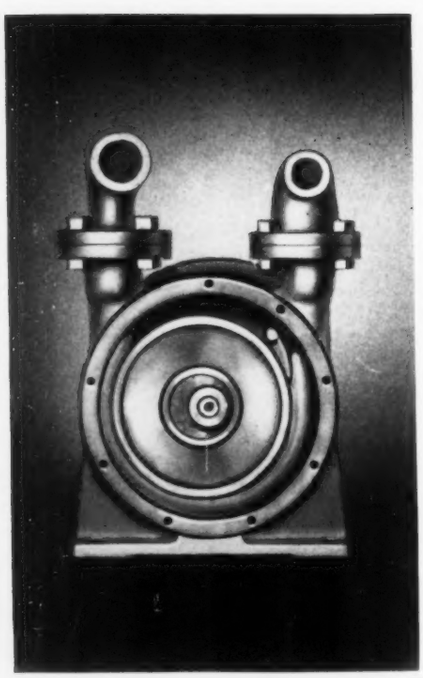


**To increase operator efficiency** and production, the Rotor Tool Company redesigned their portable grinders, reducing weight of front handle, rear handle and middle bearing section by one-third through use of magnesium alloy castings. Steel inserts support ball bearings and prevent pound and wear of the cored holes in magnesium castings. To secure firm anchorage, sufficient magnesium is provided around the inserts to prevent quick chilling of the casting. Castings are heat-treated to bring tensile strength to 35,000 lb. per sq. in. Heat treating increases hardness considerably; this is an advantage since abrasive dust on operator's gloves tends to wear away the handles.

# Pumping by Mechanical Pressure on Elastic Tubing



In the new pump designed by Huber Pump Company to handle chemicals, corrosive and abrasive liquids, a vacuum first sucks the liquid into flexible tubing and then mechanical pressure forces it out on the discharge side. The pump tubing, rubber or neoprene as required for the liquid being handled, is confined within a casing and prevented from expanding beyond its normal diameter and length. The liquid is squeezed out of the tubing by pressure applied progressively from the intake to the discharge end by an eccentric rotor revolving within a circular compressor ring. Tubing has a heavy elastic wall construction which enables it to spring back to its original form immediately after the rotor releases it, thereby creating a vacuum on the suction side while a high pressure is being built up on the discharge side. No stuffing box is required. This type of pump does not require valves on the suction side to help maintain the vacuum.

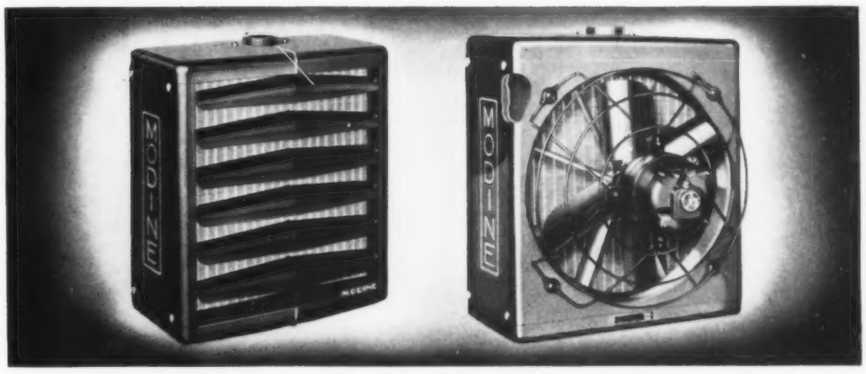
FOAMED LATEX, a comparatively recent research development, is used for seat cushions in the higher-priced 1940 cars. These cushions are of composite construction, consisting of the usual coil springs individually wrapped in burlap bags, a foamed latex pad, and a cotton pad under the trimming. This latex material is finding increasing use for cushioning, vibration-absorbing mountings, aircraft crash pads and sound-deadening applications.

WEIGHT of structural parts was reduced to one-third by use of Dowmetal in a portable X-ray designed by H. G. Fischer & Company.

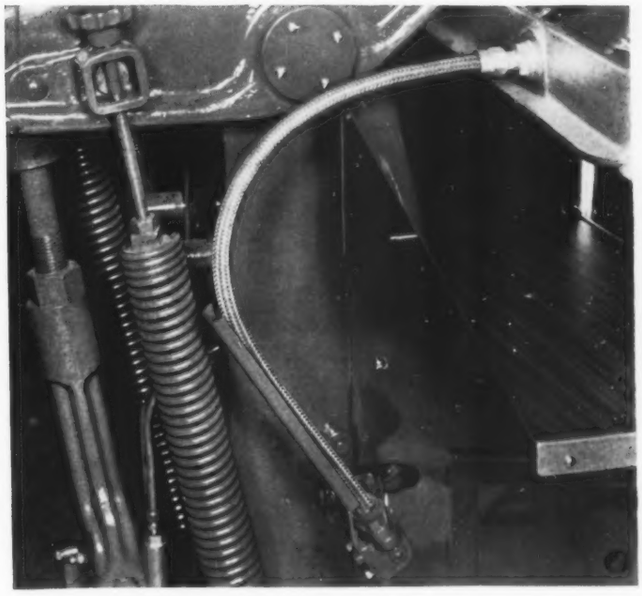
# New Materials Applications in Recent Products

**For sound silencing** the new line of Modine unit heaters, the entire casing interior is lined with an acoustical mastic; stationary vanes eliminate air-rush noise peaks; a venturi fan shroud reduces air inrush noises; concentric rings of the safety fan guard dissipate vibration, and the unit heater motor is rubber-mounted on the fan guard.

Bonderizing is used for all metal parts to prevent the formation and spread of rust and to provide a positive adhesion for the paint. Bonderized finish is especially useful on unit heaters which are exposed to corrosive fumes.



**Grease-packed ball bearings** are used throughout the Easy portable all-electric sander of the Detroit Surfacing Machine Company. Casing is wrinkle-finished. Ball bearing drive eccentric is sealed with synthetic rubber boot.



**Flexible metallic hose** for steam and return lines on laundry presses eliminates binding and speeds up movement of the ironing head in machines designed and built by American Laundry Machinery Company.

## Latest Developments in Beryllium Alloys

BERYLLIUM ALLOYS divide into four main classes: (1) copper containing from 1.5 to 2.25 per cent Be and 0.2 to 1.5 per cent of a third element such as Ni, Co, or Si; (2) copper containing 0.4 per cent Be and 2.6 per cent Co; (3) copper containing 0.1 per cent Be and 0.4 per cent Cr; and (4) various nickel base alloys of 1.5 per cent to 3 per cent Be, now in the stage of engineering development.

Class 1 alloys have high fatigue strength, excellent wear resistance and fair electrical conductivity. Class 2 have good electrical conductivity, good fatigue strength, 100 million cycles at 32,000 lb. per sq.in., good impact strength and high temperature stability. Class 3 alloys have high electrical conductivity, high temperature stability, good fatigue strength, high impact resistance, and excellent spring properties. *R. H. Harrington, Research Metallurgist, General Electric Company.*

| Class | Proportional Limit | Tensile Strength | Per cent Elong. in 2 in. | Elec. Conductivity | Stability Temp. deg. C. |
|---|---|---|---|---|---|
| 1 | 45–70,000 | 100–175,000 | 3–12 | 20–35% | 225 |
| 2 | 45–60,000 | 90–120,000 | 10–20 | 45–55 | 500 |
| 3 | 20–35,000 | 50–75,000 | 10–20 | 70–77 | 500 |

# SOME IMPORTANT ADVANCES IN PLASTICS

DEVELOPMENTS in the formulation of plastics have been numerous. Many new materials, both in the pressure molding and the injection molding types, and older materials with improved properties have been announced and have greatly extended the field of applications for plastics.

PLASTIC RESIN SHEETS composed of a thermoplastic resin of copolymerized vinyl acetate and vinyl chloride are available in any color, transparent, translucent, or opaque. Three choices of finish are offered, calender, matte, or high gloss. The material is non-flammable, has low moisture absorption, and holds its size and shape; no aging is required after manufacture. (12)

PLASTICIZED RESIN CALENDERED SHEETS can now be obtained that are flexible enough to withstand folding and repeated flexing. Sheets, having an elongation up to 250 per cent with a tensile strength of 3,000 lb. per sq. in., when stretched return slowly to their original dimensions. These new materials will not oxidize or crack, nor do they mold or mildew, and are completely resistant to water and perspiration, and will not discolor or develop any odor from moisture absorption. (13)

POLYVINYL ACETAL RESIN for safety glass inter-layers, methyl methacrylate resins for medical instruments, synthetic bristle materials for tooth, hair and industrial brushes, are among the significant developments in plastics. (14)

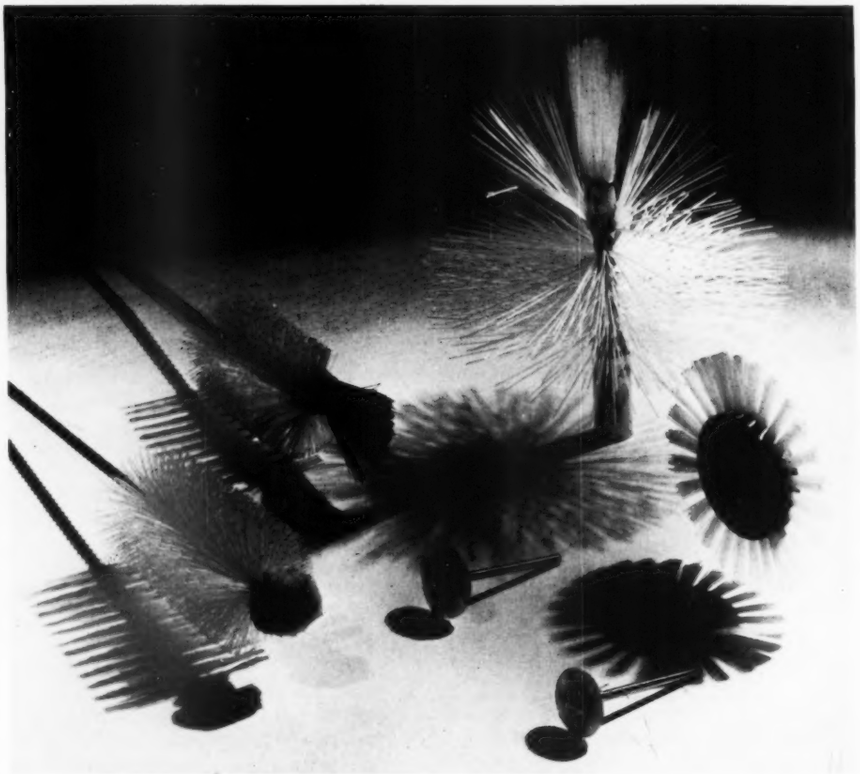
UREA PLASTIC MOLDED PARTS are displacing many stamped parts in the construction of accounting devices. Another advance in the applications for urea plastics has been the development of a material for large indirect reflector bowls designed to give a daylight effect. (15)

WOOD VENEER is being treated with plastic material, made by dipping thin veneer of wood in phenolic or urea resin, depending on the color desired. After drying the material is subjected to heat and pressure. The thin veneer is generally cut into slices and woven to give a basket effect. The resultant material retains the natural luster and appearance of wood, yet it is permanent, plastic and durable. (16)

THERMO-SETTING PLASTIC materials that can be injection molded have made their appearance during the past year. These materials are finding ready acceptance for many molded parts. One plastics molder has done considerable injection molding with this material, and he reports having made some parts which contained large inserts. (17)

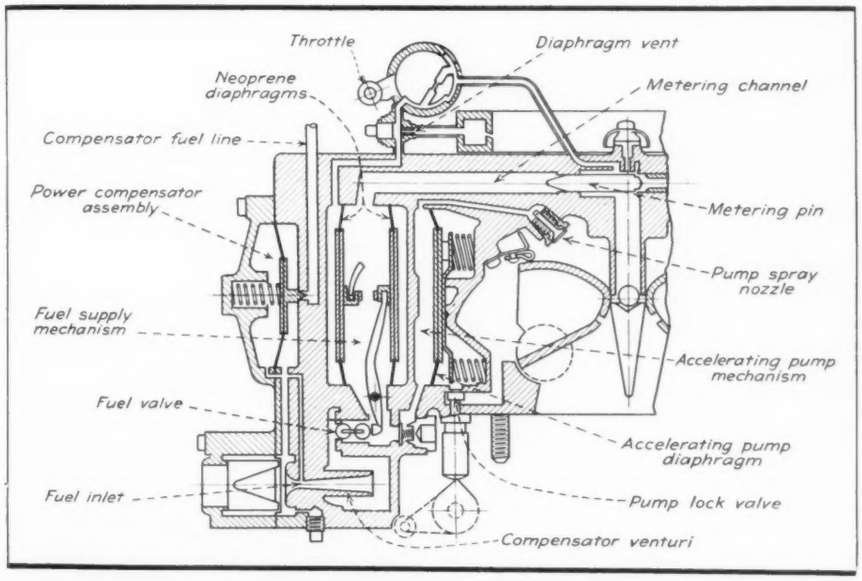
DEVELOPMENTS in production include automatic machines for pressure molding thermo-setting plastics and also progress towards perfecting a new molding process wherein the material is preheated in an auxiliary mold from which it is transferred into the molding cavity, all on the same machine. Coating of metals with plastics (PRODUCT ENGINEERING, March, 1939, p. 107) and new methods for combining metals and plastics (PRODUCT ENGINEERING, November, 1939, p. 493) have opened further new design possibilities.

Many other plastic and synthetic materials have been improved and have found increasing fields of application many of which are described in this number. See page 4 for itemized index.



**Brushes** for bottle washing and for dental polishing made with nylon bristles

# Plastics, Synthetic Rubber in New Products




**To eliminate effects of gravity,** splashing and tilting, this new aircraft carburetor controls the fuel mixture by means of neoprene diaphragms instead of the conventional float mechanism. Opposite sides of fuel chamber are of synthetic rubber connected by linkages to the fuel valve. Pressure of liquid fuel in chamber tends to close the valve; engine suction tends to open valve. Other neoprene diaphragms compensate for rapid acceleration and for additional fuel for richer mixtures at high power engine output.

**Turn indicator** which fastens to left hand front door and is operated by cable from driver's seat. This Mallory automobile accessory has two plastic lenses, injection molded of amber and ruby Tenite II, the newly developed cellulose acetate-butyrate. A flasher button in the ruby lens draws attention to the signal which swings out at right angles to the car when the driver is making a turn. When cable is released, arm returns and is held flush to the door. In this position flasher is disconnected and amber lens is visible to driver approaching from left.

**Funnel** in the Hamilton Beach fruit juice extractor is molded from a combination Bakelite and Rogers Board, to obtain additional strength. Two ribs on the outside of the plastic funnel fit into grooves in the metal bowl, preventing it from moving about while the fruit is being squeezed. The removable drip cup fits directly under the metal bowl of the extractor, eliminating waste. Handle, funnel and drip cup are molded of Bakelite by Eclipse Moulded Products Company. Steel parts are chrome-finished.

## APPLICATIONS OF SYNTHETIC RUBBER

SYNTHETIC RUBBER coatings are being applied by a blower manufacturer. Other uses are:

Oil well equipment
Electric shavers
Gaskets for lenses on signal lamps
Radiator valves
Radio condensers
Bearing seals on electric motors
Tank car seals
Hoses and seals on brush machinery
Gaskets for electric switch housing
Oil seals for electric truck motors
Diaphragms in pressure controllers
Bumpers and washers on instruments
Water pumps
Vibration dampers
Picture projection machines
Coverings on paper coating rolls
Bushings for rocker joints on vibration screens
Seals on pulverizing machinery
Seals on shoe machinery
Household refrigerators
Oil burners
Synthetic rubber hose
Textile machinery
Neoprene valves on pumps
Oil field machinery

Of 54 manufacturers of machine tools and similar production machinery seven report an increasing use of synthetic rubber. 44 new specific applications, reported by 474 manufacturers, range from bumpers on instruments to hose on construction machinery.

# Full Feathering Propeller Hydraulically Actuated

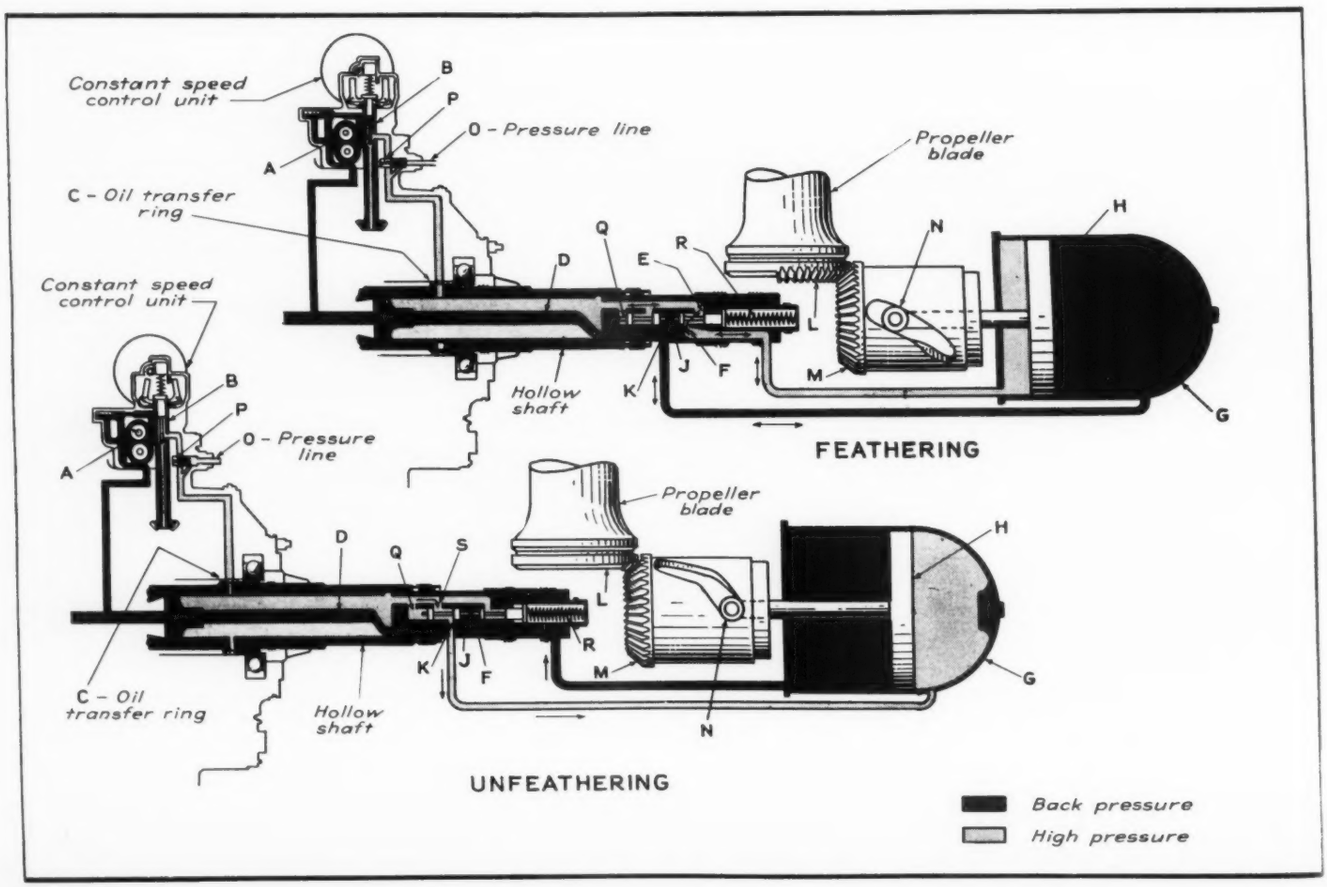
FULL-feathering propellers during the past year have become standard equipment on almost all multi-engined aircraft. The mechanism of this development which was originally announced late last year represents the third major advance in controllable propeller design contributed by Hamilton Standard. First of these was the common two-position controllable pitch propeller, originally introduced nearly 10 years ago, marking the first application of the "gear-shift" principle to airplane design.

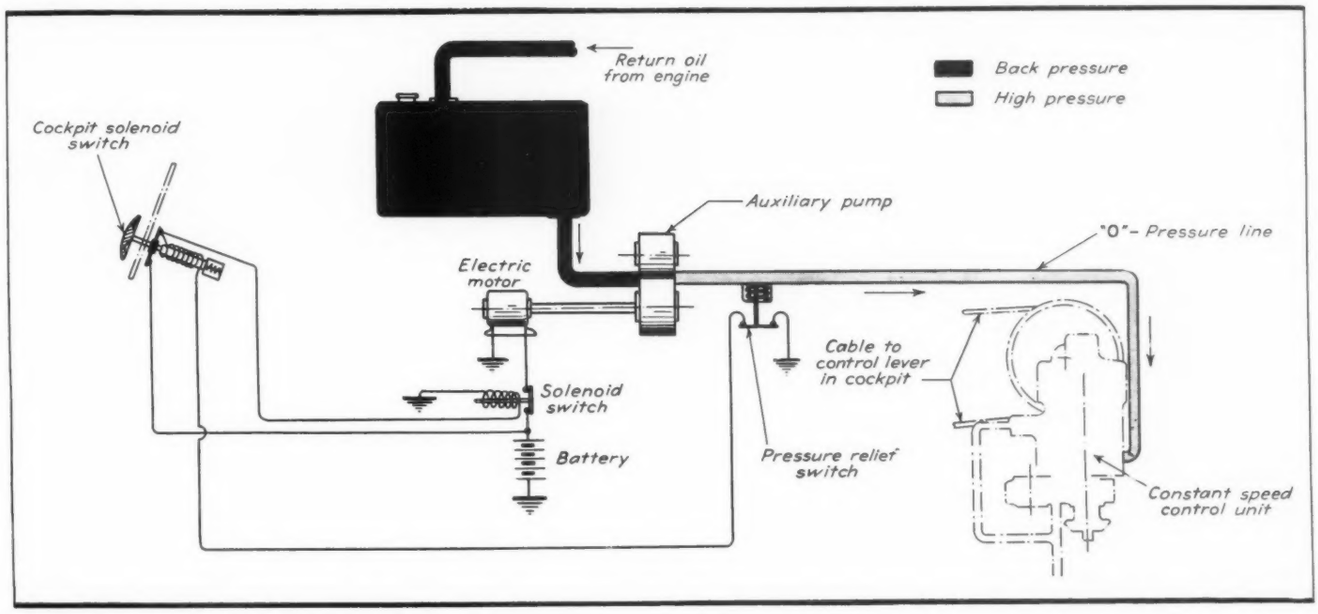
The Hydromatic propeller retains the hub and blade mounting structure of the older Hamilton Standard types, further improved by a molded collar of plastic material between the roller bearing race and the fillet of the blade retaining shoulder. This plastic material insures good seating of the mating parts, gives better stress distribution, and protects the aluminum alloy blade from any chafing action, thus increasing its resistance to fatigue. The plastic layer also permits use of an oil seal between the hub and blade. Such an oil seal would not be considered safe in direct contact with the aluminum alloy blade, as it might lead to stress concentration. With an effective oil seal it is now possible to maintain a fairly high oil pressure on all the working parts inside the hub and wear of the parts is correspondingly reduced.

Means of restricting the pitch range during normal operation must be provided so that the blades cannot be feathered except by a deliberate action on the part of the pilot. This problem was solved by taking advantage of the fact that the centrifugal force acting on the blades tends to cause them to go into low pitch. Engine oil boosted to higher pressure by a constant speed governor pump is used to overcome this centrifugal twisting moment when it is necessary to increase the pitch. This oil pressure acts on a large piston and the motion of the piston is transformed into rotary motion by a series of cam rollers acting on coaxial helical cams of opposite pitch slope. For the normal pitch range the cam follows a steep helical angle to obtain high mechanical advantage. When the pitch reaches the maximum operating value, the slope of the cam becomes flatter and mechanical advantage of the piston is insufficient to overcome the centrifugal twisting moments of the blades when normal operating pressures are used. Thus, a maximum pitch limit is provided for normal flight conditions. If a considerably increased oil pressure is supplied from some other source under the control of the pilot, the piston will overcome the blade twisting moment and the pitch will increase until the feathered setting is reached.

### *Hydraulic Operation*

Pump is mounted between the engine oil tank and the constant speed control, and sends oil under pressure through line *O* to the cut-out valve built into the base of the constant speed control. The auxiliary system shown at the right allows the pump to draw its oil from the engine oil tank; alternative installations have employed either a separate oil tank or used the hydraulic system of the airplane in place of engine oil and the special pump. The pump rapidly builds up pressure in line *O*, disconnecting the governor from the propeller and at the same time opening this pump line to the propeller by compressing spring *P* in the cut-off valve. This feathering oil pressure is transmitted to the rotating propeller shaft past the oil transfer rings *C* through port *E* of the distributor valve assembly, out port *F* to the inboard side of the piston *H*. The piston forces the engine oil, on its outboard side in the dome *G*, through ports *K* and *J*, into the oil supply pipe *D*, and back into the engine lubricating system.






As the piston moves out, the blades move to a higher pitch, and the motion is finally stopped by the rotating cam coming against an adjustable mechanical stop (not shown in the sketch) set for the fully feathered position of the particular blade design being used. With all motion stopped and the feathering pump still functioning, the feathering oil pressure builds up until it reaches 400 lb. per sq.in., at which point a pressure cut-out switch opens the electrical circuit operating the pump by de-energizing the solenoid holding the cockpit solenoid switch in. With the blades feathered, engine rotation is stopped and consequently the blade centrifugal twisting moment and engine oil pressure have dropped to zero, and the blades remain in feathered position. The entire feathering operation is accomplished in 9 sec. average time.

### *Unfeathering*

To unfeather the blades, the pump is again started to build up a pressure greater than 400 lb. per sq.in. by physically holding the cockpit solenoid switch closed. At approximately 500 to 600 lb. per sq.in. pressure, the force at *Q* at the base of the distributor valve in the propeller is great enough to force the distributor valve out, compressing spring *R*, and the valve moves toward the position shown in the left bottom view disconnecting the engine oil system from the dome. The oil from the pump starts to fill up the dome on the outboard side of the piston through ports *S* and *K* as the distributor valve moves out, and this oil starts pushing the piston in, unfeathering the blades. The oil on the inboard side of the piston is forced out through ports *F* and *J* into the engine oil system. The unfeathered propeller in an airplane moving through air starts to windmill. When the engine reaches a reasonable rpm, the cockpit solenoid switch is released by the pilot. The propeller continues to windmill, cranking the engine, and it is thus possible to start the engine running again. The moment the feathering pump stops, the spring in the cut-out valve in the governor disconnects the feathering pump line from the propeller and places the governor back into the system, and the propeller runs again at the speed for which governor is set.

### *Two Oil Supply Sources*

The Hydromatic propeller during normal constant speed operation requires two simultaneous sources of oil supply, one from the constant speed control booster pump and the other from the engine oil system. Oil from the constant speed control pump *A* is permitted to enter the hollow drive gear shaft *B* of the governor and thence to the propeller shaft when the engine is turning faster than the speed for which the governor is set by the pilot in the cockpit. Governor oil is thus metered at the top port of the drive gear shaft, and enters the rotating propeller shaft by means of the oil transfer rings *C*. It then follows the same path described for the oil during the feathering operation to the inboard side of the piston.

At the same time, oil from the engine lubricating system under normal engine oil pressure enters the propeller mechanism through the supply pipe *D* in the center of the propeller shaft, and reaches the outboard side of the piston through ports *J* and *K*.

The governor oil pressure builds up until it exerts a force greater than the sum of the forces which oppose motion of the piston outward into the front of the dome. These forces are: engine oil pressure times the effective piston area; net blade twisting force consisting of blade centrifugal twisting moment modified by aerodynamic twisting moment; friction of the moving parts of the propeller mechanism.

When governor oil pressure builds up to a value greater than the sum of these three forces, the piston starts to move out toward the front of the dome, and engine oil in front of the piston is displaced back into the engine lubricating system. This outward movement of the rotating cam increases blade pitch and engine speed is thus slowed down. As the engine slows down to the speed for which the constant speed control is set, the pilot valve in the governor descends to the position shown in the top section view of the governor at left, thus shutting off the top port of the drive gear shaft and cutting off the supply of governor oil from the booster pump to the propeller.

Should the engine rpm fall below the speed for which the governor is set, the pilot valve in the governor descends still further, opening the bottom of the drive gear shaft to drain. Engine oil in the dome at the outboard side of the piston is always, during normal propeller operation, under pressure from the action of the engine oil pump. This pressure acts as if a spring were placed between the outer end of the piston and the front of the dome, the spring, however, having the unusual characteristic of exerting a constant force regardless of the amount of its compression. The blade centrifugal twisting moment, aided by this "spring" force, moves the piston inward overcoming friction and the back pressure existing in pushing governor oil back through the governor to drain. As the pitch of the blades thus decreases, the engine speed picks up and the pilot valve in the governor is raised, closing off the drain through the drive gear shaft just as the engine reaches speed for which governor is set.

# SOME NEW DESIGNS AND ASSEMBLIES OF MECHANICAL PARTS

MANUFACTURERS of parts, units and subassemblies have announced a great number of new products. Some of the most interesting include automatic release clutches, hydraulic transmissions, a new screw thread form system, synthetic rubber surfaced belting, and lubrication devices.

AUTOMATIC RELEASE CLUTCHES. One type is designed so that the clutch slips at a pre-determined torque in order to stop the driven machine as soon as an obstruction or excessive torque is encountered. In another arrangement the clutch slips when an obstruction is encountered, but after a fraction of a revolution of slippage, the clutch disengages itself automatically, and can also be arranged to operate a limit switch. (18)

HYDRAULIC VARIABLE SPEED DRIVE UNITS have been developed that can be "time" controlled either by small synchronous motors or by a pendulum to give absolute speed in r.p.m. Pre-set speeds are held to plus or minus ¼ per cent of rated speed when load changes are gradual. Speed is not affected by changes in voltage, frequency, speed of drive to pump end, load, oil temperature or running fits. These precision control devices enable a hydraulic drive to follow precisely the speed of a remotely located master unit, at any desired ratio. (19)

LUBRICATOR PUMPS actuated from the hydraulic system and synchronized to the regular machine cycle, are increasing in use along with hydraulically operated mechanisms in the machine tool field. The most significant development during the past year, aside from the much wider use of automatic centralized pressure-lubrication with metered oil-feed, has been the tendency of equipment manufacturers toward building the lubricating equipment still further into the machine elements, thus achieving a more thorough integration. (20)

FLEXIBLE TUBING made of 18–8 stainless steel is now available in fully corrugated units and also in the divided bellows type wherein the center portion of the unit is straight tubing and the ends are corrugated into bellows. These units are furnished with threaded or plain ends, steel or stainless steel, fittings welded to the neck of the bellows. (21)

NEEDLE ROLLER BEARINGS in small sizes have been developed for aircraft control applications. Several new designs of ball bearing rod-end bushings have been brought out for aircraft. (22)

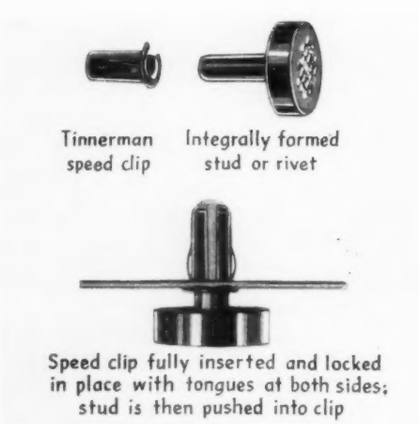
NICKEL TUBE, 0.0026 in. O.D. x 0.0007 in. I.D., is believed to be the smallest tube yet produced. The manufacturers are discussing the production of an even smaller size, though as yet such tubes have little or no commercial use. The tube serves to illustrate, however, the extent to which modern fabrication methods have progressed. (23)

PHILLIPS-TYPE SCREWS are being used extensively by a manufacturer of bus seat assemblies. Advantages claimed are that passengers cannot remove the screw with a dime or knife blade and that no slivers which might injure hands or clothing are produced in driving. (24)

NEEDLE BEARINGS: one manufacturer of needle bearings has added the following standard new sizes to his line: $\frac{3}{16}$ in. shaft, $\frac{13}{16}$ in. shaft, and $1\frac{3}{8}$ in. shaft, thus supplying some sizes which have not been readily available. (25)

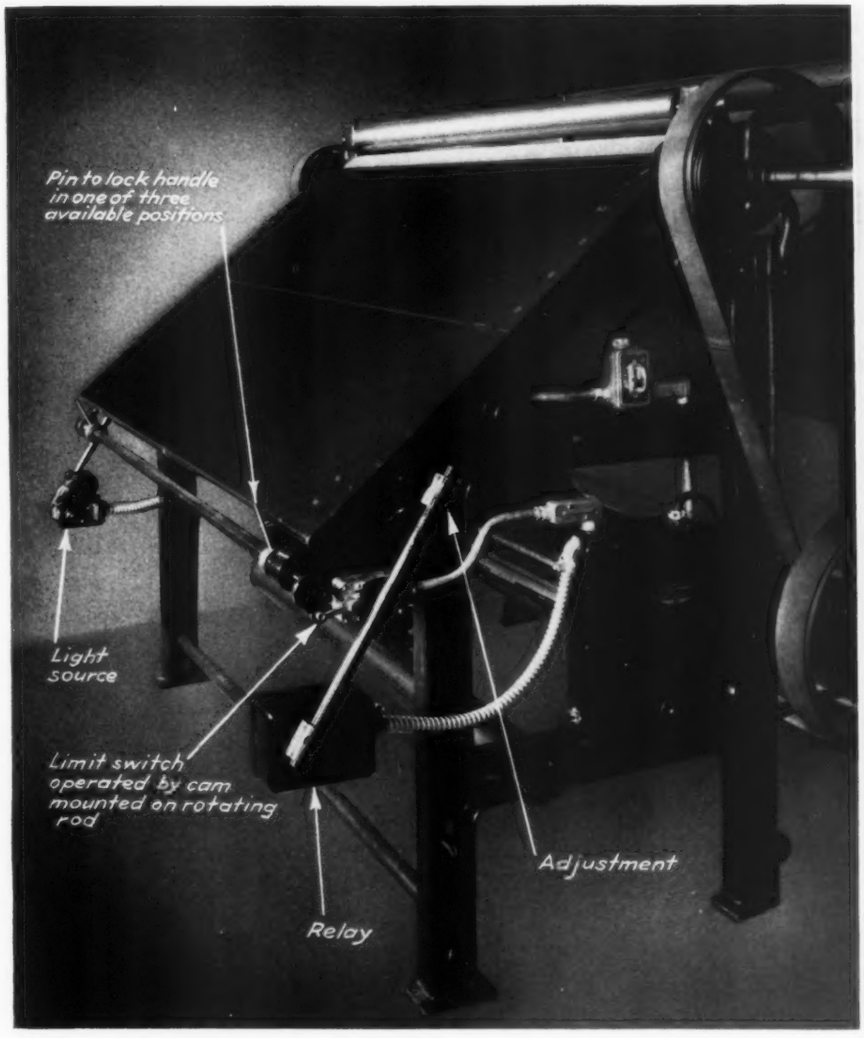
SELF-TAPPING SCREWS for fastening and assembling parts to malleable, gray iron, aluminum and zinc castings, and also plastics are now available. An F-fluted shaped pilot on the screw cuts the thread in the material as the screw is turned in. Standard machine screws of corresponding size can be turned into the thread formed in the material by this screw. (26)

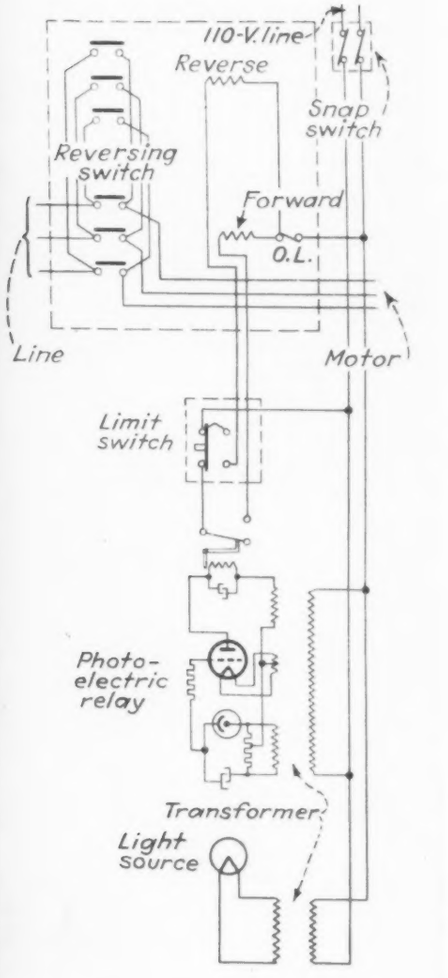
Included in new mechanical parts are: a speed reducer and motor assembly made up of three unit parts, coolant pump with a double suction impeller, an air operated valve with pilot controls, diesel engine exhaust metal hose in sizes from $2\frac{1}{2}$ to 4 in. I.D., and flexible metal tubing reinforced with a laminated cellulose covered braid. See page 4 for itemized index.


Tinnerman speed clip
Integrally formed stud or rivet
Speed clip fully inserted and locked in place with tongues at both sides; stud is then pushed into clip
Spring steel speed clip partially inserted in hole. Tongues at right and left are compressed and invisible
When stud is pushed completely "home" the curled-in end of the speed clip bites into stud to lock it securely

**Spring fasteners** of new tubular type available in three types—permanent locking in which the stud cannot be removed, removable locking type, and also slidable grip type in which the stud can be pulled out with the fingers.

# Interrupted Light Beam Controls Textile Machine


Pin to lock handle in one of three available positions
Light source
Limit switch operated by cam mounted on rotating rod
Relay
Adjustment




**Photoelectric control** as applied to the Curtis & Marble Machine Company cloth-inspection machines, one of the new applications in the textile machinery field. Control of the machine is had by interception of the light beam with the operator's knee or foot. Position of light beam can be adjusted by movement up or down of the mounting castings supporting light source and relay.

Cam-operated limit switch is mounted on a rotatable rod. A pin in rod collar in conjunction with detents in casting against which collar bears holds the rod in desired position. Three positions are available: first, magnetic reversing switch energized for forward motion when the beam of light is interrupted; second, both contacts in the limit switch open when beam is interrupted rendering machine inoperative under all conditions; third, switch energized for reverse motion. Reverse movement is manually controlled; light beam is not used.

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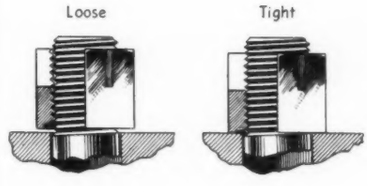


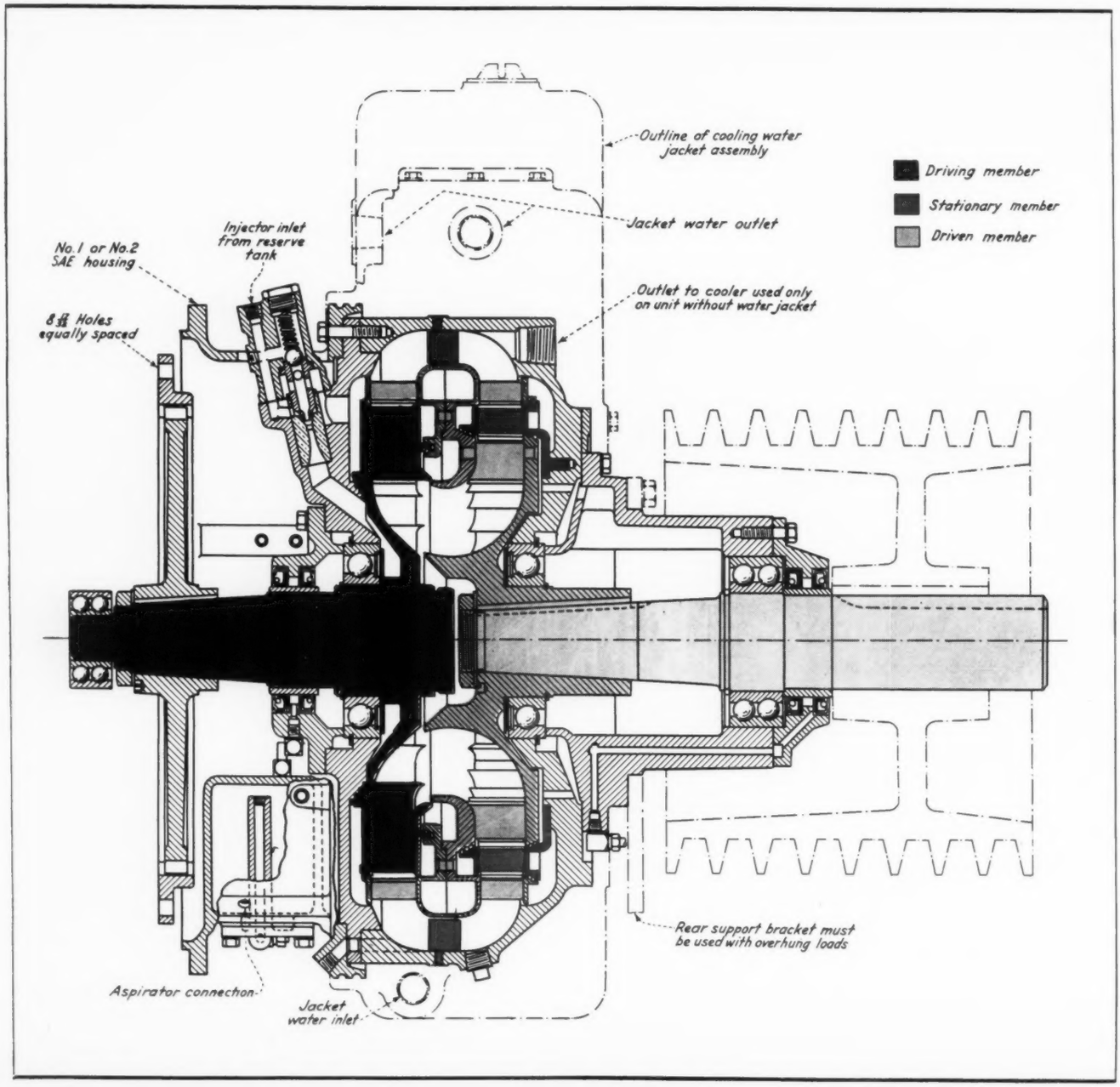

Self-Locking Connecting Rod Bolt Nut

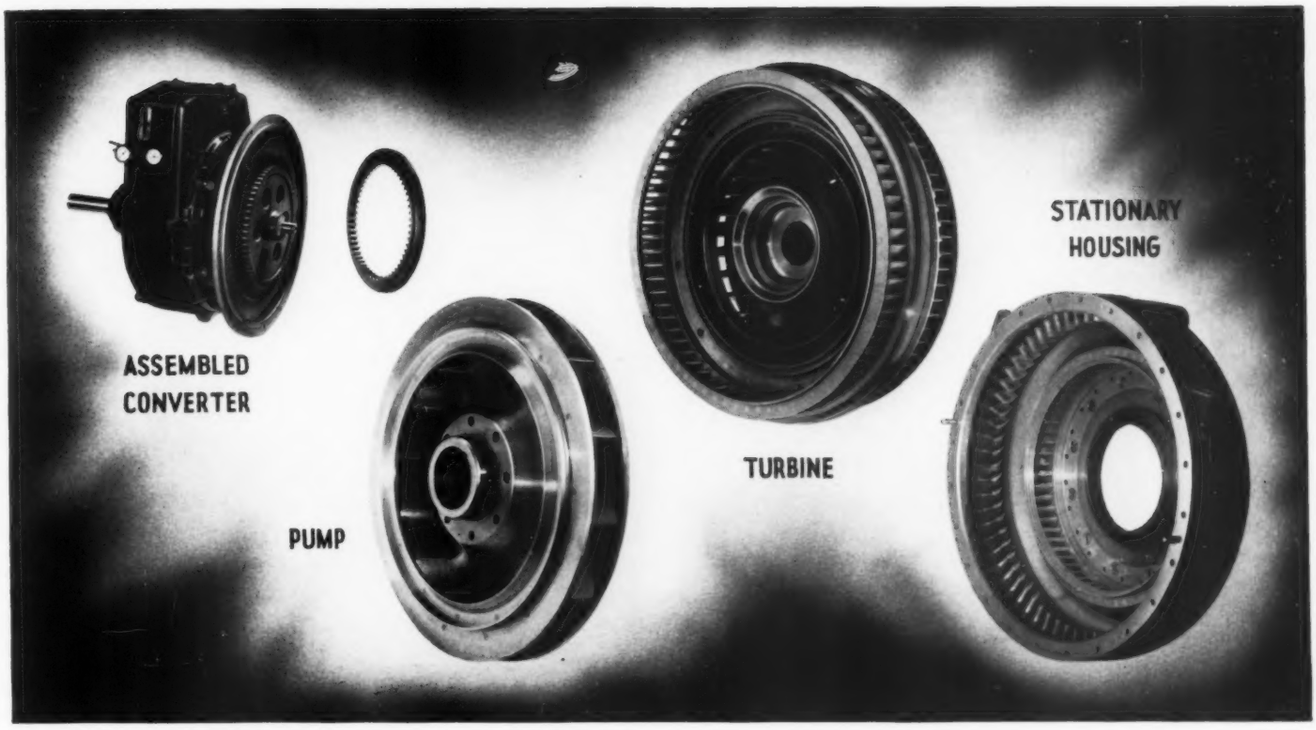
**Self-locking** connecting rod bolt nuts replace the castellated nuts and cotter pins in connecting rods for 1940 automobiles. New nut can be tightened down securely to exactly the correct degree of tightening, as there is no necessity of backing off part of a turn in order to insert a cotter pin. Made much the same as an ordinary castellated nut, this new design includes a circular recess machined into the clamping surface. When the nut is tightened down it tends to deform slightly, drawing the slotted sectors into pressure contact with the bolt threads, locking the nut securely in place.

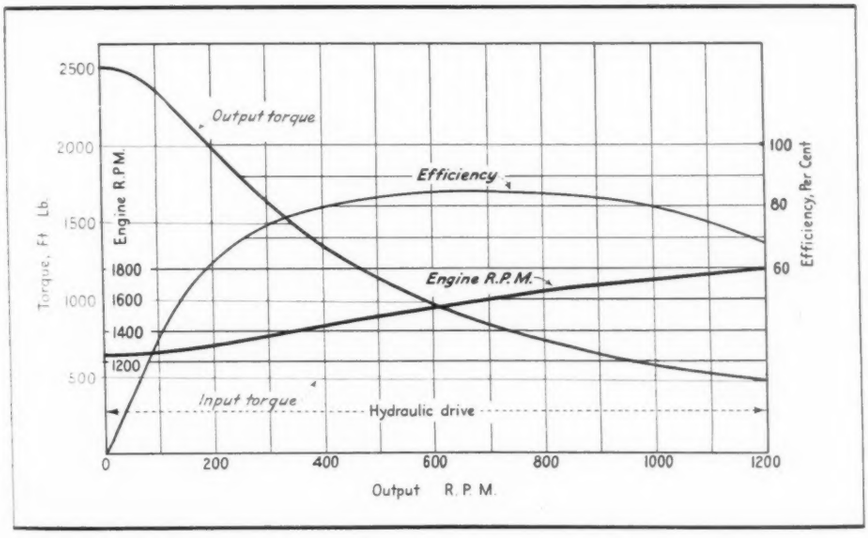
**CHAIN DRIVE CALCULATIONS. New design analysis proved by experiments and performance records completely upsets existing concepts regarding the effects of centrifugal force on the load carrying capacity of chain drives. Application of this new design analysis results in high-speed, ultra-silent, space-saving drives of greater horsepower capacity. Developed by engineers of the Morse Chain Company, this analysis will be presented in detail in January PRODUCT ENGINEERING.**

# Twin-Disc Hydraulic Torque Converter

BOTH the hydraulic coupling and the hydraulic torque converter are essentially a co-axial centrifugal pump and reaction turbine both operating in a hydraulic chamber. In the impeller or pump, the fluid absorbs kinetic energy and thereby imposes the corresponding load on the engine or driving member. In the runner or turbine, kinetic energy is released through the loss of rotational velocity as the fluid is forced toward the center, this energy becoming available at the output shaft. Horsepower is in proportion to the cube of the speed and torque developed in proportion to the square of the speed. Both the horsepower and torque are in proportion to the fifth power of the diameter. This may be expressed by means of the equation $T = C \times n^2 \times D^5$, $HP = C \times n^3 \times D^5$. In the hydraulic coupling, the runner or driven member is the reaction turbine and input torque is always equal to output torque. Because of certain rotational losses and skin friction within the coupling, the r.p.m. of the output shaft is always somewhat lower than the r.p.m. of the input shaft, this loss being referred to as slip. The single-stage converter is based on the same principle except that a reaction member is introduced which changes the direction of the fluid travel. This member alters the torque ratio between the input and the output shaft, and since it is located in the converter housing which is bolted to the flywheel housing of the engine the reaction torque is added to the input torque resulting in increased torque in the output shaft of the converter. The power developed is in proportion to the differential of the peripheral components which oppose one another as the direction of the fluid is changed, multiplied by the number of turbine stages. The sum of all torques must therefore be zero. The converter is particularly suitable for variable speed installations and where heavy loads are to be started frequently such as in cranes, hoists and switch locomotives.


Outline of cooling water jacket assembly
Driving member
Stationary member
Driven member
Jacket water outlet
Injector inlet from reserve tank
No. 1 or No. 2 SAE housing
Outlet to cooler used only on unit without water jacket
8 ⅝ Holes equally spaced
Rear support bracket must be used with overhung loads
Aspirator connection
Jacket water inlet



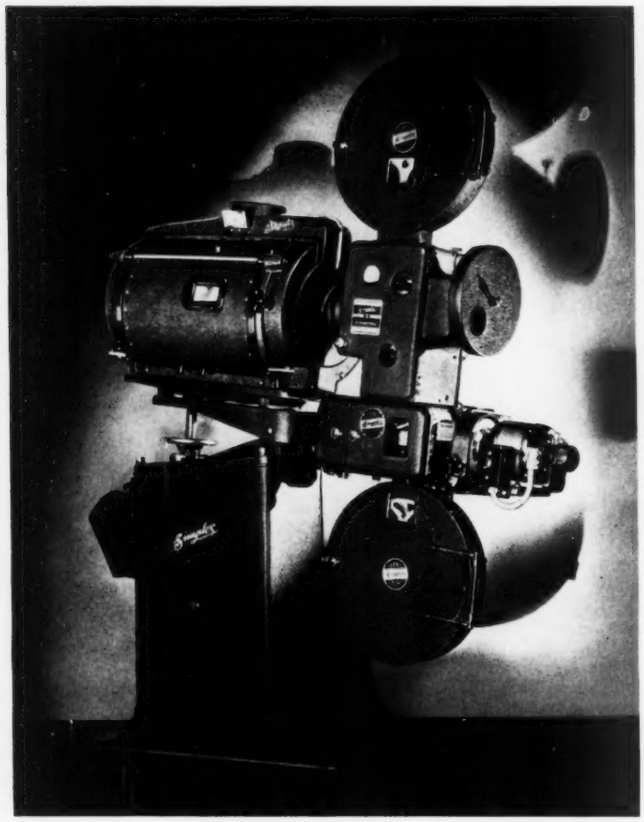



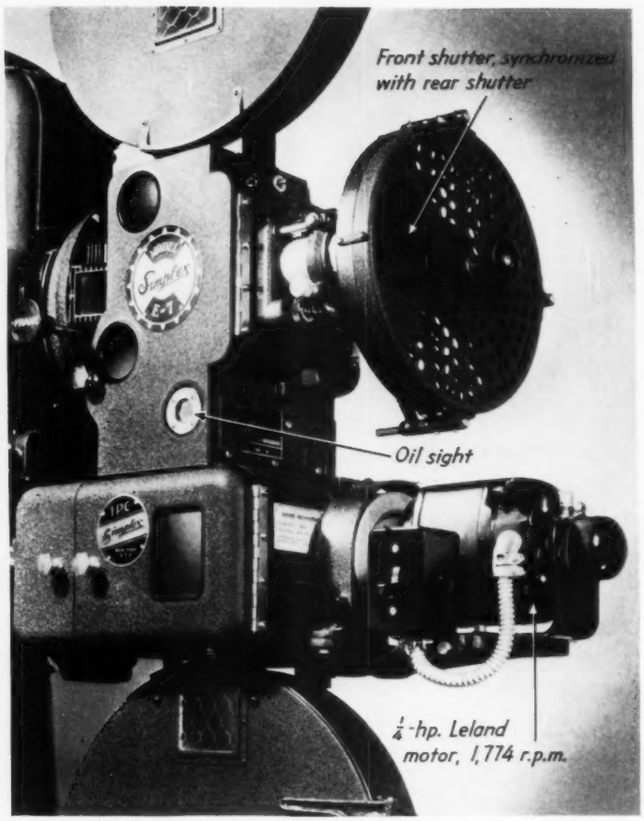

**Torque increase** obtained in this Twin-Disc converter is generated as the circulating fluid passes alternately through and reacts against the stages of the turbine and stationary blades of the housing. Labyrinth seals prevent short circuiting of the fluid between the individual stages as well as between the rotating parts and the stationary housing. Synthetic rubber seals retain the fluid in the housing. The small amount of leakage passing these seals is collected in the converter sump and is automatically returned to the reserve tank by the aspirator, operated by means of continuous flow of fluid under pressure coming through a small line from the top of the converter into the reserve tank. Injector draws the required make-up fluid from the reserve tank to replace fluid leakage passing the synthetic seals.

**Hydraulic characteristics** of the Twin-Disc converter are such that the power absorbed by the pump is proportional to the cube of the speed. The capacity of the converter pump must therefore be balanced to conform with the power delivered by the engine; the engine will then operate at nearly constant speed, and the pump will absorb power delivered by the engine regardless of the speed of output shaft of converter. In actual operation there is approximately a 20 per cent drop in the engine speed over the range from maximum speed down to the stalling point of the secondary shaft. The operating range of the secondary shaft is from zero to approximately two-thirds of the corresponding engine speed; at this point the torque available at the output shaft is equal to the torque of the engine. Efficiency of the converter is a direct function of speed ratio and reaches its maximum with the output speed approximately one-half of the input speed. As engine speed is reduced for corresponding output shaft r.p.m., the efficiency curve moves over to the left since for a given ratio of output versus input the efficiency of the converter remains constant, hence it is possible to operate the converter at light loads and low speeds with good efficiency. Hence the converter can be applied to advantage wherever variable speed operation is required and where high torques at low r.p.m.'s are needed for the starting of heavy loads. These applications include hoists, cranes, switching locomotives, and oil field equipment.

ANOTHER TYPE of hydraulic converter unit, for applications such as rail cars and similar equipment, has been developed by the Twin Disc Clutch Company. The high starting torque developed in hydraulic drive, and the additional speed range and maximum efficiency in direct drive for normal propulsion and high-speed operation are both obtained in this unit. Drive from the engine is through either one or the other of the driving plates in the Twin Disc patented duplex clutch.

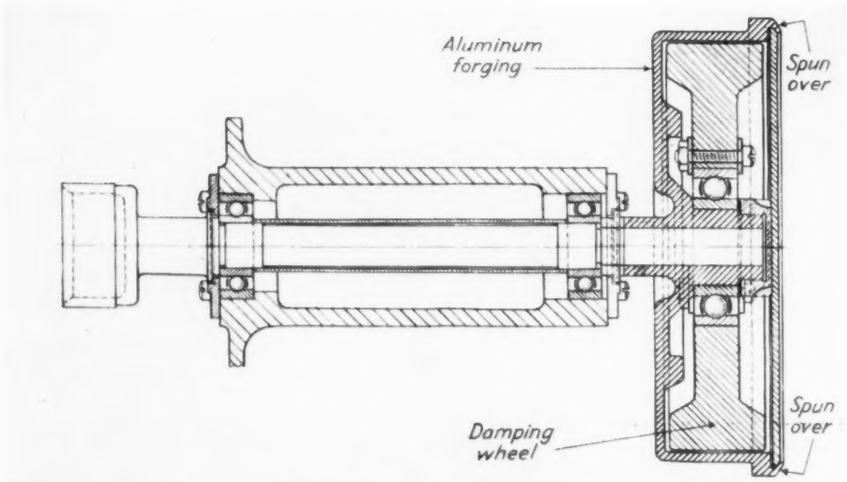
# Synchronized Shutters, One-Shot Lubrication

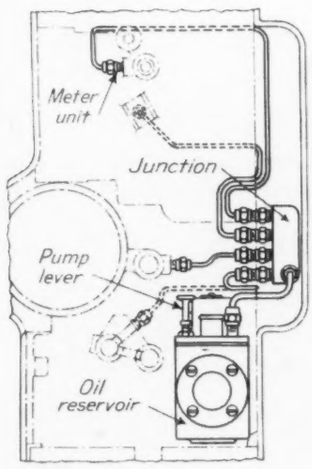





**Built to precision specifications,** the Simplex film projectors of the International Projector Corporation embody numerous improvements in the use of materials and mechanical equipment. Mechanism contains molded, forged, die-cast and stamped parts, laminated and molded plastics, alloy steels and equipment such as built-in metered lubrication fittings and ball bearing mountings. Base comprises a welded steel column on a cast iron footing. Exterior is wrinkle-finished.

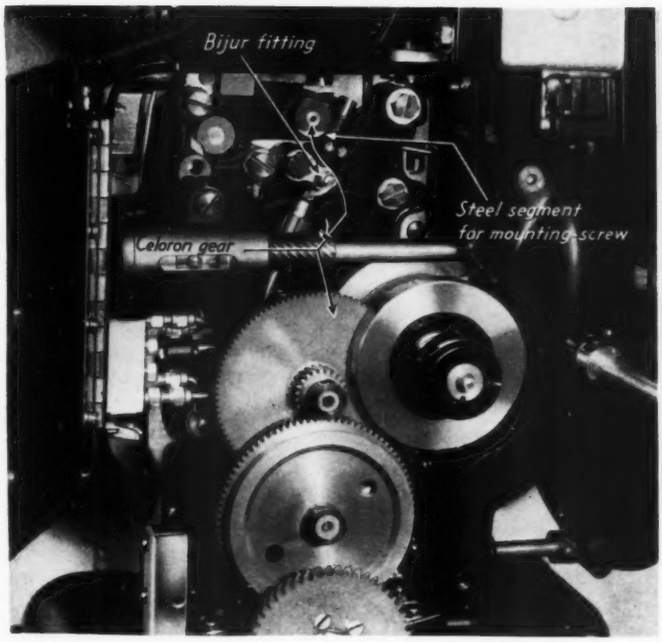
**Air deflector** interposed in light beam between rear shutter and arc lamp consists of a metal frame supporting heat-resistant Pyrex glass. Translucent barrier at this point prevents disturbance of arc flame by air currents from shutter fins, cuts off heat from film. Carbon dust and dirt cannot be drawn into mechanism; this lengthens film life and improves reproduction. Synchronized front and rear shutters each act on one-half light beam. Successive waves of darkness meet at image center.

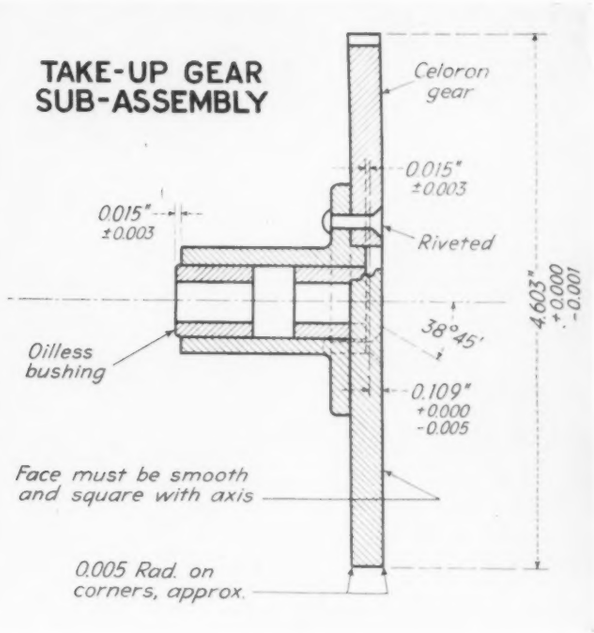


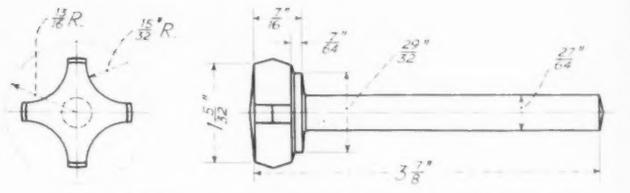

**Rotary stabilizer,** housing of which is an aluminum forging, maintains constant velocity of film past the optical slit in reproduction unit. Film travels on scanning drum surface. Scanning drum and stabilizer are attached at opposite ends of same shaft. Stabilizer maintains film velocity through projection mechanism within 0.15 of one per cent or less than 0.003 ft. per sec. variation.

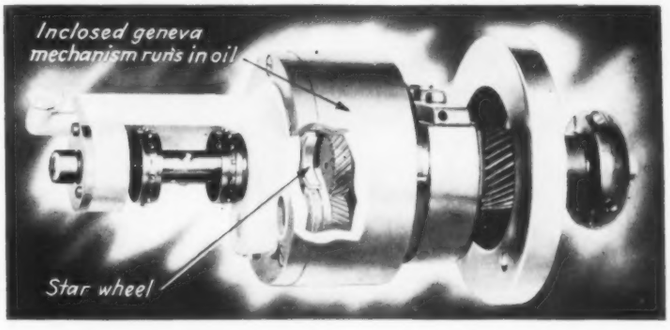
**Metered lubrication** is designed as an integral part of projector mechanism. Centralized Bijur system consists of lubricator pump, oil reservoir, and four meter units at projector bearings.



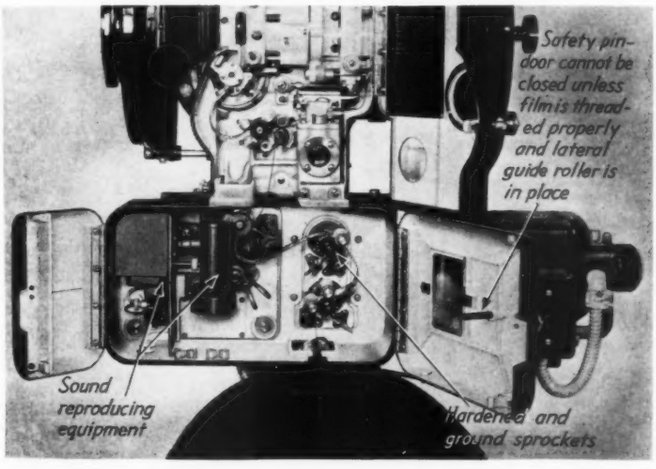



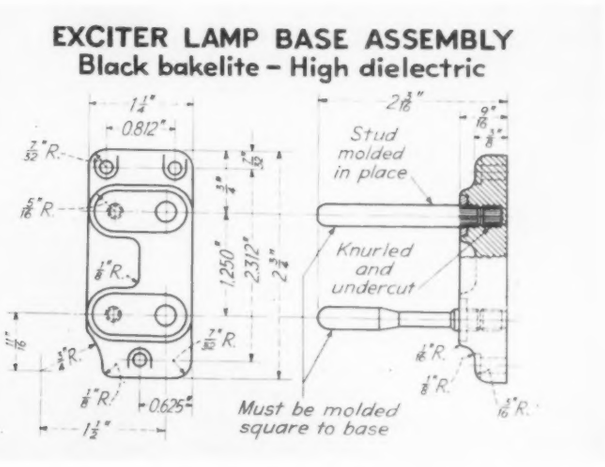

**Oversize drive gears** revolve on fixed studs. When repairs are required, rebushing of main frame is unnecessary. High speed shafts are mounted on ball bearings; slow speed shafts are mounted on oilless bearings. The Celoron sprocket gear has a flat surface machined on the hub; this surface supports the steel segment holding mounting screw.


STAR WHEEL BLANK-DROP FORGING:
Oil hardening tool steel, normalized and annealed hardness not to exceed 90-95 Rockwell on "B" scale




**Film speed** through projector is 90 ft. per min. or 24 frames per sec. Geneva movement ratio allows 1/96 sec. time to move film a distance of ¾ in. Each frame is magnified 350 to 500 times; 345.000 individual frames cover area of a 30 by 40 ft. screen. This is equivalent to a linear length of approximately 4 miles of 35mm. film. Therefore, star and cam are held to manufacturing tolerances that permit a maximum of 0.2 of one per cent "jump" on screen. This includes initial errors in film.


Safety pin-door cannot be closed unless film is threaded properly and lateral guide roller is in place
Sound reproducing equipment
Hardened and ground sprockets




**Exciter lamp** for reproducing equipment is mounted on a molded dielectric phenolic bracket which slides on two pins molded as inserts in the bakelite base. Die castings are used for exciter lamp housing and for the photoelectric cell brackets.

# SOME RECENT DEVELOPMENTS AND DESIGNS IN ELECTRICAL PARTS

NEW FEATURES and improvements in electrical equipment, controls and accessories made during this year have opened up new possibilities for designers. Included in the many new designs are cast copper rotors, glass insulated motors, a variable speed motor-clutch unit, rectifiers, and heater units.

COPPER ROTORS centrifugally cast for squirrel-cage motors, are being manufactured in which the rotor bars and end rings are formed in one piece. As a result of the centrifugal casting operation, a dense, ductile copper structure is produced with full slots and high conductivity. (27)

GLASS INSULATION has influenced the design of motors in two directions: Space economy, by permitting the use of smaller sizes and higher temperature ranges; and overload capacity with consequent increased reliability in motors of standard sizes, because of the high-temperature tolerance of glass insulation. (28)

SPEED VARIATION with indefinite slip and control of torque transmitted is obtained with new adjustable speed unit which consists of a standard constant speed a.c. squirrel cage motor in combination with an eddy current clutch. Speed range can be extended from zero to full speed. Units in sizes of 30 hp. and smaller are available with a source of d.c. excitation for the clutch consisting of a stepdown transformer and a rectifier. A rheostat for controlling the output speed can be mounted at a distance from the motor-clutch unit. (29)

STRAIGHT LINE PUSHING or pulling unit operated in both directions by an electric motor has been developed, in which limit switches stop movement at any predetermined point of travel or thrust. Time clocks can also be used to initiate or stop the mechanism to synchronize with correlated apparatus. (30)

THERMOSTATIC MOTOR SWITCH of new design with auxiliary breakers which provide control and overload protection for a.c. or d.c. motors of 1 hp. or less, through thermostatic action. After overload, the handle automatically returns to the "off" position. When thermostat has cooled the mechanism relatches and is ready for starting when the handle is thrown to the "on" position. Contacts are silvered to insure long life. Movable roll contact recedes into a recess in the base to snuff the arc. (31)

PUSH-BUTTON CONTROL STATIONS are now styled to harmonize with modern machinery. Enclosures consist of reinforced covers molded of plastic material either in black, machine tool gray or in white. Frame is die-cast. (32)

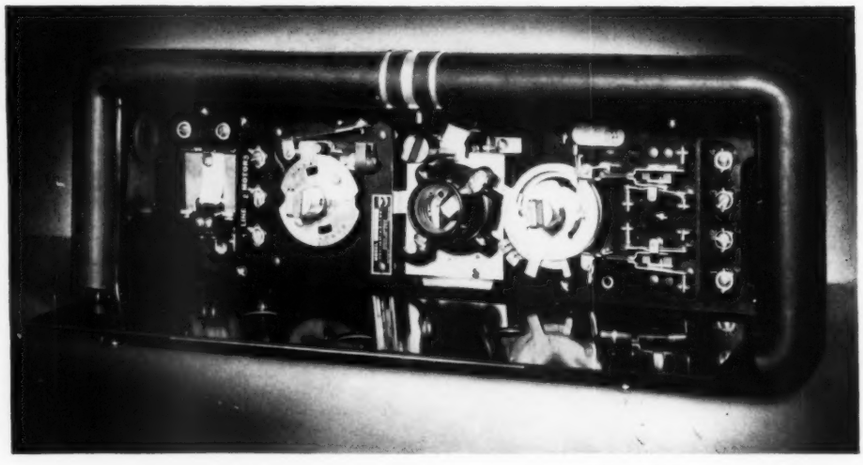
MAGNET ALLOYS such as Alnico are finding many new applications, because of their great magnetic strength, decreased weight. A ¼-hp. motor with multi-pole armature of Alnico automatically reverses upon stalling. (33)

RECTIFIERS WITH SELENIUM PLATES are now made which are claimed to withstand overloads of 75 per cent for several hours without deterioration. These rectifiers are manufactured to order in full wave bridge or half wave types for practically any d.c. voltage and current output. (34)

HEATING ELEMENT ALLOYS with longer life properties give the designer of electric units a choice of obtaining longer life or using higher temperatures at the surface of the wire. Another improvement in these alloys is an increase in ability to hold up in wattage. (35)

STRIP HEATERS for operation at sheath temperatures up to 1200 deg. F. have been announced. The heaters are enclosed in porcelain-enamel steel casings in order to resist rust and corrosion, also to improve appearance. (36)

For other electrical parts and their applications mentioned in this number see page 4 for itemized index.

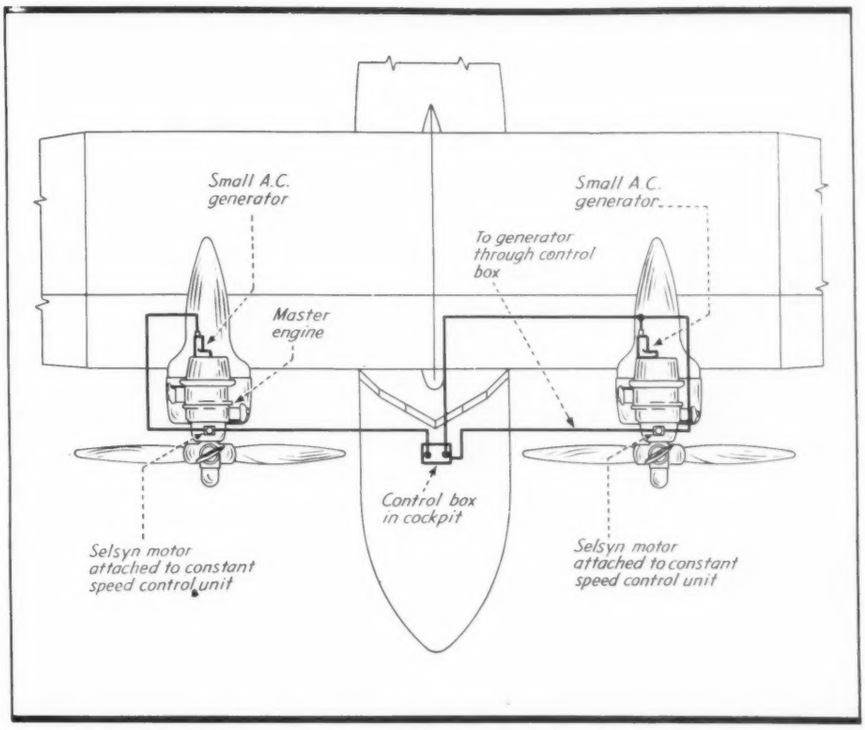


**Control panel** for gas, oil or coal furnaces built by Schwitzer-Cummins Company. The assembly is furnished ready for installing complete with all necessary electrical controls and a prefabricated wiring harness making it unnecessary for the installer to be familiar with control circuits.

# Selsyn Synchronizer for Multi-Engined Aircraft

A DIFFERENCE of only 20 r.p.m. in operating speed between two engines will cause a distinct beat every three seconds throughout the airplane structure. Since it is difficult to read an engine tachometer to within 20 r.p.m. during flight, the pilot has to adjust engines manually until the "beat" disappears, and in a four-engined airplane manual synchronization has been a tedious process. Even after synchronization variations in operating conditions may throw engines out of phase.

With the new Hamilton Standard synchronizer, these difficulties are eliminated by a synchronizer circuit which operates on a combination of electrical and mechanical principles. Speed of any engine is governed through adjustment of the pitch of the propeller by a small differential three-phase Selsyn motor attached directly to the propeller control. The differential motor will not rotate when the frequency of the power being supplied to one of its windings is the same as the frequency of the power being supplied to the other winding. If the two frequencies differ, the differential motor will rotate in one direction or the other, depending on which frequency is the higher. Power supplied to one winding of the differential motor on any given engine comes from a small generator driven by the same engine. Power for the other winding comes from a generator driven by the "master" engine, which may be any one of the other engines in the airplane. If the speed of any engine differs by so much as one r.p.m. from the speed of the "master" engine, there will be a difference in frequency, causing the differential motor on that engine to rotate and to actuate a worm rack which increases or decreases the tension on the constant-speed control spring that changes pitch of propeller.


Small A.C. generator
Small A.C. generator
To generator through control box
Master engine
Control box in cockpit
Selsyn motor attached to constant speed control unit
Selsyn motor attached to constant speed control unit

*Schematic wiring diagram of the synchronizer installation on a two-engined airplane*

Since the speed of rotation of the differential motor is directly proportional to the difference in frequencies being supplied to its two windings, as an engine approaches the speed of the "master" engine, the differential motor will rotate more slowly, change in speed of the engine will become slower, and there will be no tendency for engine to "hunt."

Manual adjustment of the speed of the engines may be accomplished by switching off the synchronizer and operating an individual toggle switch for each engine, located on a control box in the pilot's cockpit.

Whether engine speeds are being changed manually or automatically, each differential motor is equipped with two adjustable limit switches which operate when either maximum r.p.m. or minimum r.p.m. of the engine is reached to shut off the differential motor, and at the same time to operate a clutch and brake which disconnects the motor from the worm rack and stops the propeller control from further movement. A small signal light for each differential motor, located on the cockpit control box and actuated by the limit switches, informs the pilot when either extreme of propeller pitch adjustment has been reached.

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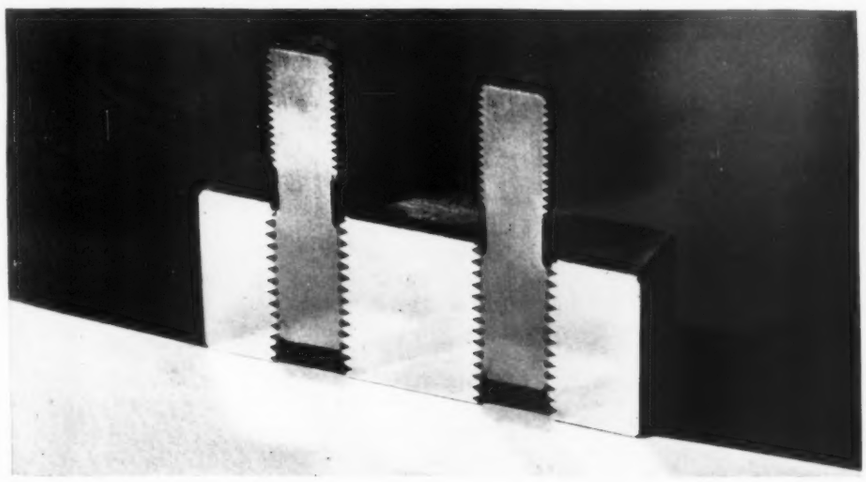
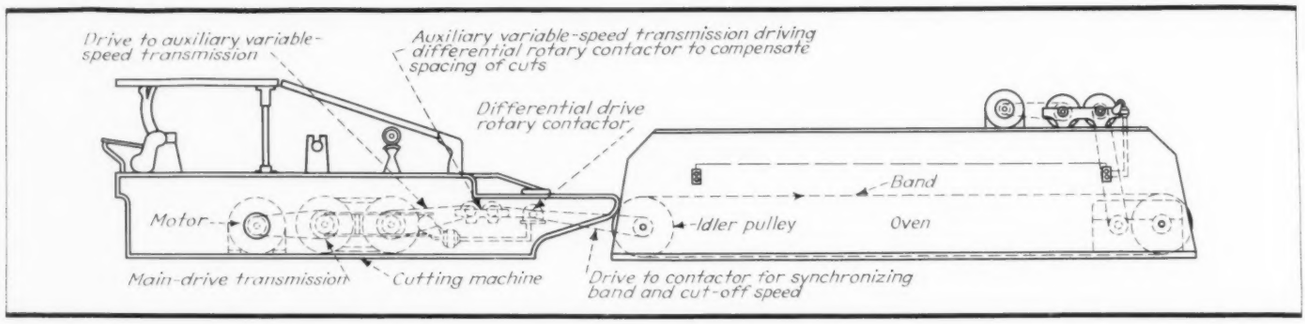
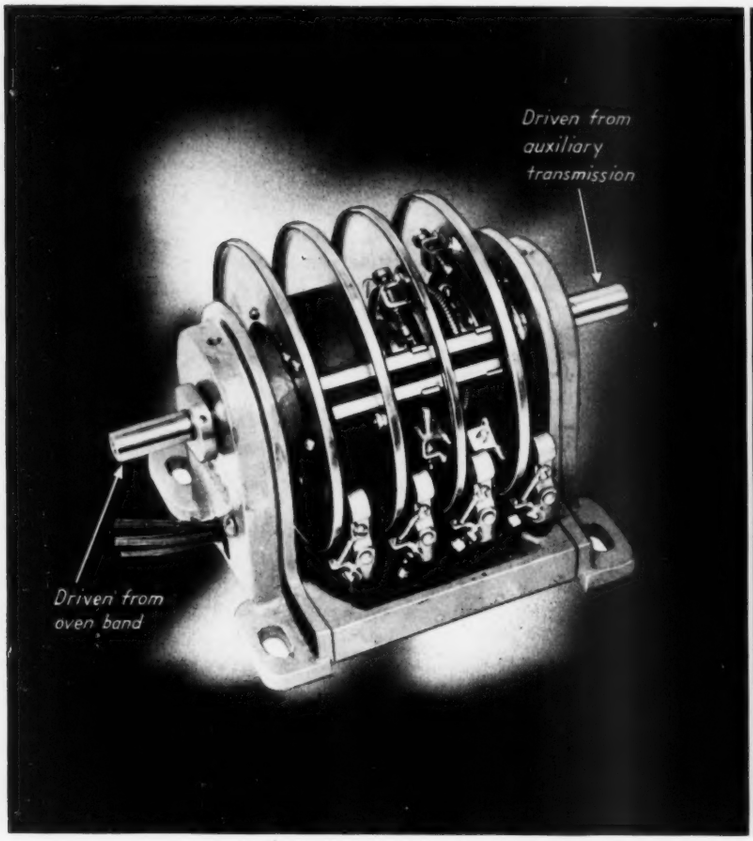


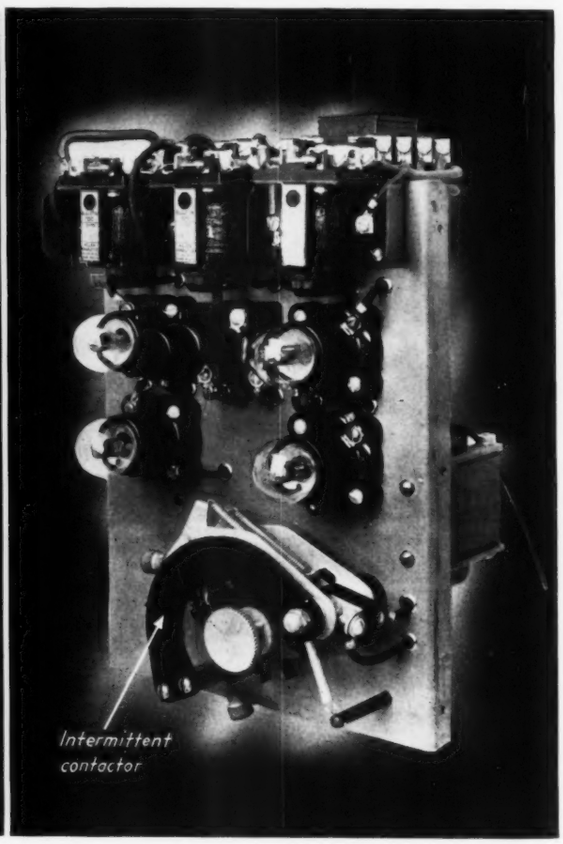
**Aero-Thread,** a new screw thread system in which the screw engages with a specially formed spring wire inserted into the tapped hole. The insert acts as a protection to the threads and provides a smooth, hard bearing surface. The screw has a shallow thread of circular form which is claimed to produce a screw member of increased strength under impact and fatigue loadings, for details see "Strength of Screw Threads," page 474, November 1939 PRODUCT ENGINEERING. The strength of the thread in the tapped hole depends on the shear strength at base of thread. The system is designed to compensate for the difference in expansion of the steel screw and light alloy parts, thereby preventing high stress concentrations under varying temperatures.

# Synchronizing and Tension Controls




**Pilot motor control** of a Lewellen transmission synchronizes speed of conveyor in a baking oven with the apron speed of the dough cut-off machine. An auxiliary transmission driving the contactor controlling the pilot motor permits compensation when there is more waste material and the crackers must be placed closely together on the oven band. Thus the oven band would run at a slower speed in relation to the apron speed of the cutting machine when a greater amount of waste material occurs between rows of crackers; if there is only a slight amount of waste between rows of crackers, the oven band runs at practically the same speed as the apron on the cutting machine.



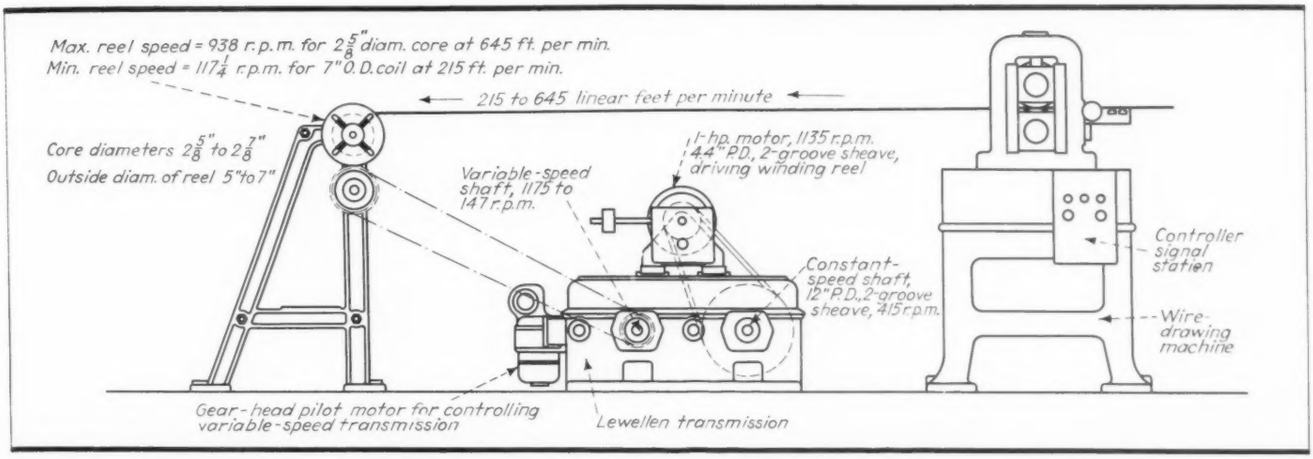




**Rotary contactor** has two independent drive shafts on the same centerline, each driving a pair of disks. One shaft is driven from the oven band; the other from the auxiliary transmission.

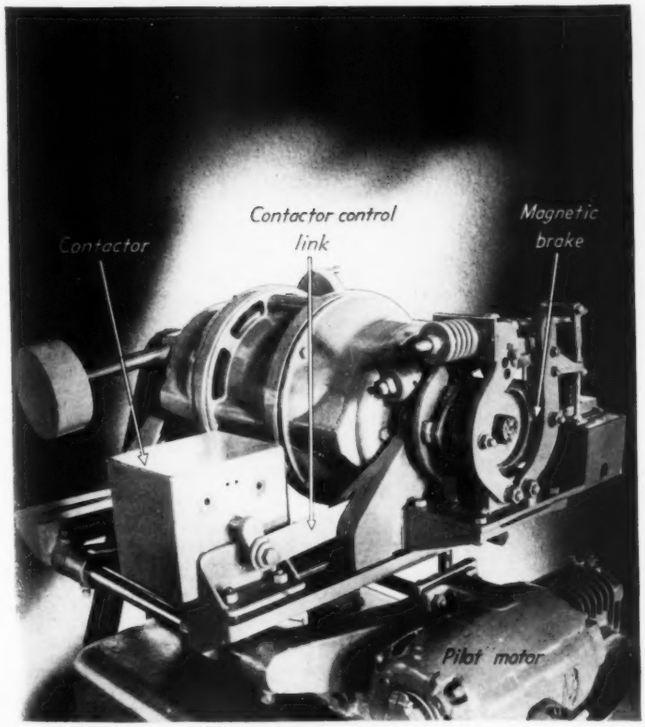
The speed relation between the two traveling conveyors is controlled by changing driving ratio between variable-speed shaft of cutting machine transmission and the side of the rotary contactor which it drives. With both shafts of contactor running at the same speed, no control action takes place; if these shafts change their speed relation two contacts are engaged in a circuit which passes through an intermittent controller. On the next closing of controller contacts a slight speed correction is made on transmission driving the cutting machine.

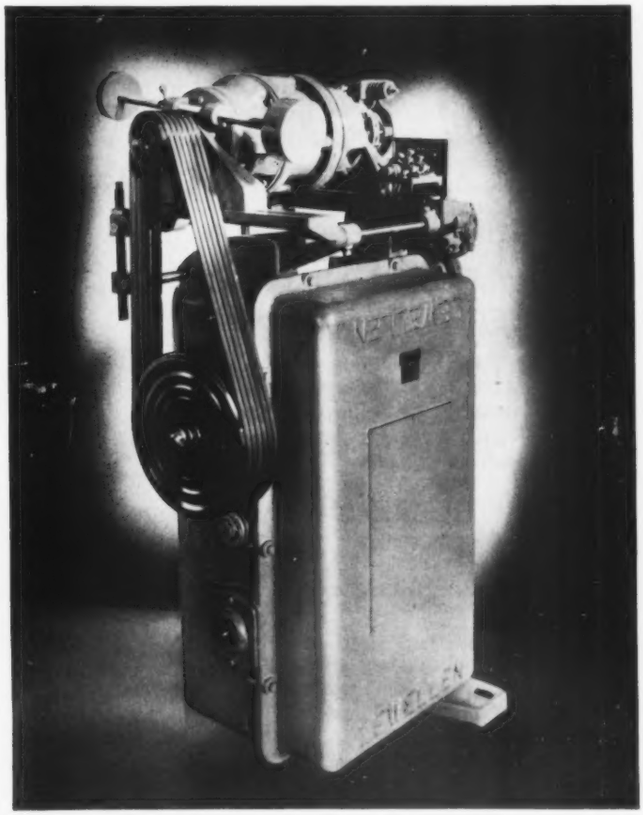
This control cycle is repeated until the two machines are in synchronism. Cutting machine apron is driven from variable speed shaft of the main transmission; one side of rotary contactor always runs at a certain speed relation to the cutting machine apron.

Control panel at right carries relays, reversing switches, signal lights and intermittent controller driven by a constant-speed geared-head motor having a cam on the slow speed shaft. The cams have teeth which engage and disengage contact points at regular intervals. The length of time contacts are in engagement is adjustable, and time between contacts is fixed by the number of teeth in cam and speed of cam shaft.


Max. reel speed = 938 r.p.m. for 2 5/8" diam. core at 645 ft. per min.
Min. reel speed = 117 1/4 r.p.m. for 7" O.D. coil at 215 ft. per min.
215 to 645 linear feet per minute
Core diameters 2 5/8" to 2 7/8"
Outside diam. of reel 5" to 7"
Variable-speed shaft, 1175 to 147 r.p.m.
1-hp. motor, 1135 r.p.m. 4.4" P.D., 2-groove sheave, driving winding reel
Constant-speed shaft, 12" P.D., 2-groove sheave, 415 r.p.m.
Controller signal station
Wire-drawing machine
Gear-head pilot motor for controlling variable-speed transmission
Lewellen transmission

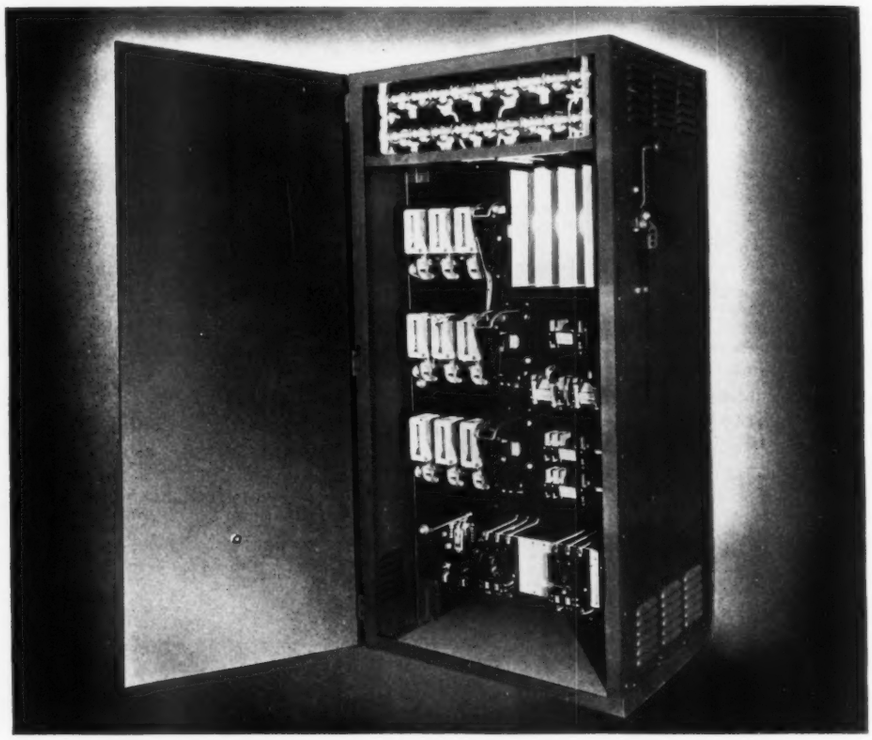
**Tension Control.** Wire passes through a wire drawing machine driven by a separate transmission, hand controlled to give linear speeds of 215 to 645 ft. per min. Uniform tension is maintained as the wire is wound on the reel by continually slowing down reel speed the amount necessary to maintain tension and to wind wire at the speed the wire drawing machine is running. Signal lights assist the operator in making the proper adjustments of the contacts.



**Dynamometer-mounted motor.** Oscillating shaft of the contactor is connected by a crank and arm mechanism to motor stator. The adjustable weight can be locked in any position by handwheel. By moving the weight in relation to the motor center greater or less V-belt tension is required to balance the motor. Increase in tension tilts stator and operates the Lewellen contactor. Contacts in contactor are in series with the controller, and inasmuch as the contact points are continually engaging and disengaging in this controller, first engagement of the contacts at the contactor closes the circuit through the switch coils and makes an adjustment of the pilot motor on the transmission, reducing the speed of the mandrel to maintain constant tension on the material. The pilot motor is fitted with a magnetic brake which prevents over-running, hunting or surging.

# Dynamic Braking Control for Engine Lathes



IN this Monitor control system control units are mounted on an ebony asbestos panel above which is supported the resistor. The entire group is then inclosed in a heavy-gage sheet metal cabinet. External control of the main disconnect switch and button for re-setting the thermal overload relay is provided.

Provision has been made in the circuit for control of coolant motor, rapid traverse and oil pump motors with manual starters for each operated by a small toggle switch arrangement outside the cabinet. Each of these manual starters provides overload protection for the motor. Control of these motors is entirely separate from the main motor control except that the interlocking relay *IR* is so connected that main motor cannot run unless the rapid traverse and oil pump motor is in operation. A main disconnect switch feeds the entire control equipment.

Across-the-line starting in forward as well as reverse direction is used for the main drive motor. A cushioned plug stop, for operation in either forward or reverse direction, is under control of a governor brake switch driven from the motor or an intermediate shaft. This brake switch in addition to furnishing the plug stop feature also provides automatic jogging.

Master control of the equipment is by means of a three position switch with provision for running in forward as well as the reverse direction and a central off position. Automatic jogging is obtained through a pushbutton station.

### *Circuit Operation*

The following typical sequence of operation as applied to the main drive motor applies to either direction of operation. When the master switch is thrown forward, assuming relay *IR* is closed, it connects line *L1* through the cam limit and the inch-forward pushbutton interlock momentarily to terminal 4, and thence through a normally closed interlock on relay *RR* to the coil of relay *FR*, which is the forward-run relay. This relay closes and is held in its closed position by a circuit which passes through the normally-closed interlock of relay *RR* and through a normally open interlock on relay *FR* to terminal 3 and thence to the master switch contact, which is continuously energized while the switch is in the forward-run position. Closing of relay *FR* in turn closes contactor *P* which shorts out the plugging resistor and completes an interlock circuit permitting forward running contactor *F* to close, thus operating the motor in the forward direction. After the motor has attained a definite slow speed the governor-controlled brake switch closes one of its two contacts. In the forward direction this occurs from contact *A* to contact *B* and energizes relay *FB* which relay controls the plug braking for forward operation. Closing of relay *FB* energizes reverse contactor *R* through the normally closed interlock on contactor *F*. This interlock is open when contactor *F* is closed and running in the forward direction, preventing closure of the reverse contactor until contactor *F* opens at the time it is desired to cease running in the forward direction. Therefore, throwing of the master switch from its forward position to its off position de-energizes contactor *F*, closing contactor *R*. At the same time, contactor *P* has opened re-inserting the plugging resistor and setting the circuit for plug stop. This plug stop circuit is maintained through plug switch contacts *AB* until a fairly low minimum speed of the brake switch has been reached when contact *AB* opens de-energizing relay *FB* and resetting equipment for forward operation.

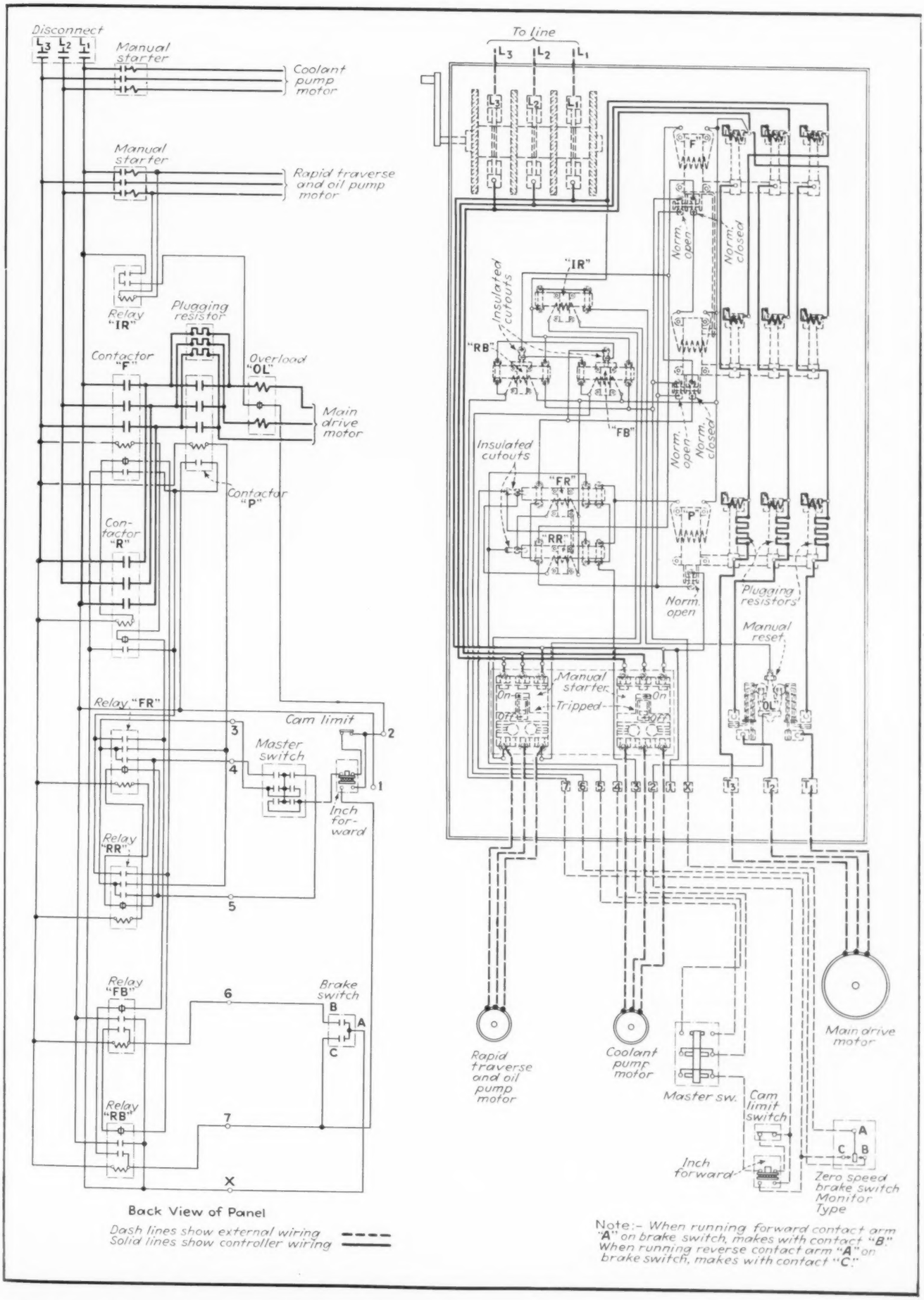
The same sequence is provided for operation in the reverse direction except that brake switch contact *AC* is involved together with relays *RR* and *RB*.

### *Automatic Jogging*

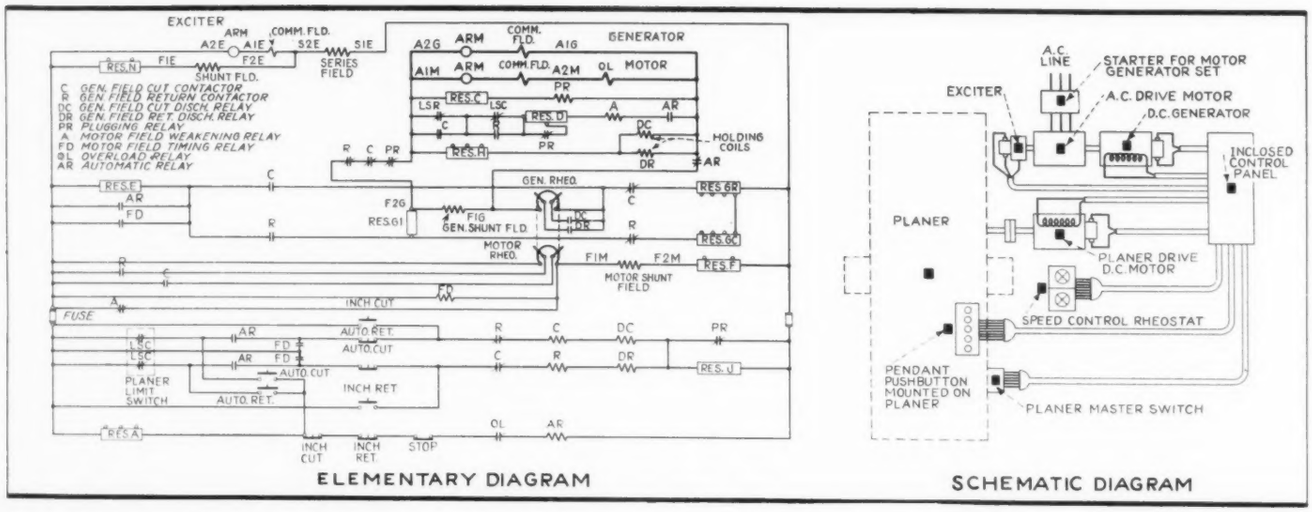
For limited motion of the lathe spindle automatic jogging is available in forward running direction only. With the master switch in the off position pressure of the inch-forward button energizes relay *RB* which through interlocks on relay *FB* and on contactor *R*, energizes and closes contactor *F* connecting the motor in the forward running direction. Since contactor *P* in this case is not energized, the forward operation of the motor is had with the plugging resistor in circuit. This condition prevails until such a time as the brake switch attains its critical low speed when contact *AB* once more closes, closing relay *FB* which in turn opens its normally closed contact and releases contactor *F*. This immediately disconnects the motor from the line permitting the equipment to slow down. Slowing of the equipment in turn opens switch contact *AB* releasing relay *FB* which permits its normally closed contact to close, re-energizing contactor *F*, increasing speed once more to the point where brake switch contact *AB* closes. Repetition of this cycle provides automatic control of jogging limiting the speed at which jogging occurs to the point at which brake switch contacts close.

Thermal overload protection of the main motor is through a thermal overload relay. It is impossible to restart motor until overload relay has been manually reset. The thermal overload is of compensated type providing protection regardless of ambient temperature.

The plugging resistor furnished is of the Edgewound type, consisting of a ribbon spirally wound on edge, provided with extra taps to permit adjustment by the operator to obtain the correct amount of cushioning desired for plug-stop operation.

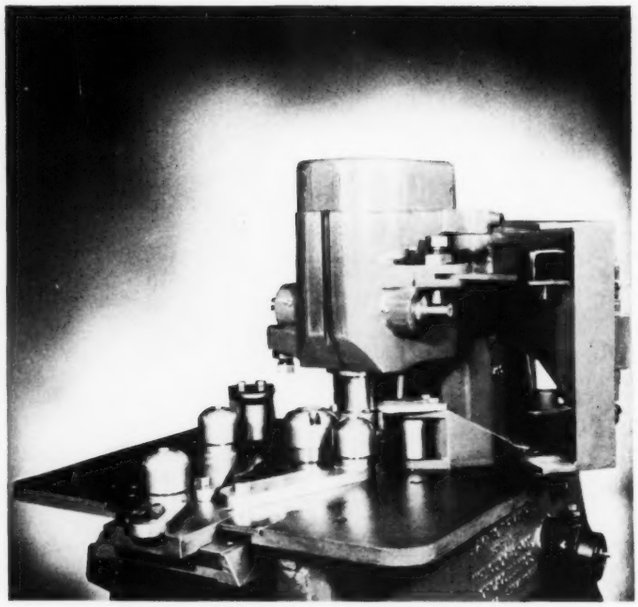

Disconnect
L3 L2 L1
Manual starter
Coolant pump motor
Manual starter
Rapid traverse and oil pump motor
Relay "IR"
Plugging resistor
Contactor "F"
Overload "OL"
Main drive motor
Contactor "P"
Con-tactor "R"
Relay "FR"
Cam limit
Master switch
Inch for-ward
Relay "RR"
Relay "FB"
Brake switch
Relay "RB"
Back View of Panel
Dash lines show external wiring
Solid lines show controller wiring
To Line
"F"
Norm. open
Norm. closed
"IR"
Insulated cutouts
"RB"
"FB"
"FR"
"RR"
"P"
Norm. open
Plugging resistors
Manual reset
Manual starter
On
Off
Tripped
"OL"
Rapid traverse and oil pump motor
Coolant pump motor
Master sw.
Cam limit switch
Inch forward
Main drive motor
Zero speed brake switch Monitor Type
Note:- When running forward contact arm "A" on brake switch, makes with contact "B" When running reverse contact arm "A" on brake switch, makes with contact "C".

# Planer Drive Offers Wide Speed Range




**Fast acceleration and deceleration,** high cutting efficiency, accuracy in stopping are available with the new variable-voltage drive for reversing planers recently announced by General Electric. In addition, the equipment gives independent selection of cut and return speeds throughout the entire speed range together with a large number of strokes per minute on all lengths of stroke. A maximum of nine contactors and relays constitute all operating devices on the control panel. Speeds range from 40 to 1,200 r.p.m. Drive consists of a planer drive motor, a d.c. generator, an a.c. drive motor, and an exciter; the last three are mounted on a single bed plate and function as a unit. Control is furnished by a speed-regulating rheostat, a planer limit switch, a pendant pushbutton station, and a starter for the motor-generator set, all mounted on an inclosed control panel. The rotating apparatus has good commutation and operates with low current peaks because of low armature inertia. Contact burning is minimized since current handled is small.

# Photoelectric Control Replaces Treadle



**Higher production speeds** and increased convenience have been obtained in the Quickwork stamping trimming machine by the substitution of photoelectric control for the conventional foot-operated treadle. With stamping in position the operator passes his hand through a light beam focused on a General Electric phototube and the machine automatically starts. Trimming operation is timed by a vacuum tube timer relay so that at the end of cut the machine opens automatically.

**Machine** is in effect a rotary shear with cutters mounted on vertical shafts. Parts to be trimmed lie horizontally on a pneumatically operated table. Electric control equipment with the exception of phototube and light source is located in the base of the machine together with the vacuum tube time-delay relay and magnetic sequencing and motor starting controls. To facilitate set-up operations, the phototube can be swung away from the table since it is mounted on a movable arm.

# SOME DEVELOPMENTS IN MATERIALS AND TYPES OF CONSTRUCTION

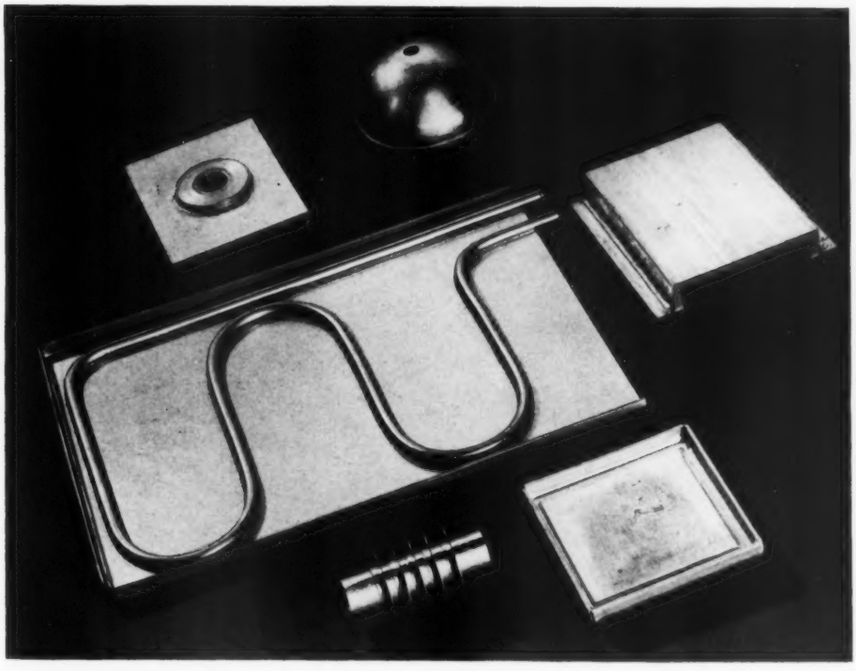
ENGINEERS AND DESIGNERS are rapidly adopting for their designs new methods of fabrication and recently developed or improved materials. Recent developments include carbide alloys, laminated plastic materials, steel stitched parts to steel, fusion welded assemblies, and automatic resistance welded stampings.

CARBIDE ALLOYS because of their wear resistant and hardness properties are being applied to metal parts as welded on overlays. Cemented carbides can now be produced in the form of tubing, spirals, round or shaped bars by means of an extrusion process. Another process makes it possible to bend to various shapes cemented carbide rods. (37)

MAGNET ALLOY MATERIALS are used by one manufacturer to provide a magnetic base for dial test indicators. With a turn of the control to the on position the magnetic base is held securely to a machine or fixture surface until the control is turned to the off position. (38)

LAMINATED PLASTIC MATERIALS are used for inner panels on refrigerator doors. The material is surfaced with a plastic resin which gives a white permanent finish. (39)

AUTOMOTIVE TRUCKS AND BUSES are using greater amounts of high-tensile steels in their construction because of state dead-weight regulations. (40)



**Aluminum parts** furnace brazed by new process developed by welding engineers of the Aluminum Company of America. The new technique of furnace brazing for aluminum makes possible a low cost method for joining together intricate shapes and delicate parts. In the process the surfaces to be brazed are fluxed. Then the pieces are brought up to a temperature above the melting point of the filler metal, but not above that of the parent metal.

STEEL FORGINGS are being used to a greater extent in construction machinery for parts that are subjected to impact and fatigue. (41)

STITCHING STEEL SHEETS to fibre tacking strips, to rubber shields and to anti-squeak materials with wire is a recent method of fastening made possible by a new stitching machine, that will drive wire stitches through 0.060 in. of steel. A total material thickness of $\frac{3}{4}$ in. can be stitched. (42)

FUSION WELDING, new technique makes it feasible to readily weld high alloy steels. (43)

AUTOMATIC RESISTANCE WELDERS of recent design have lead some designers to use resistance welded stampings in place of die-castings. (44)

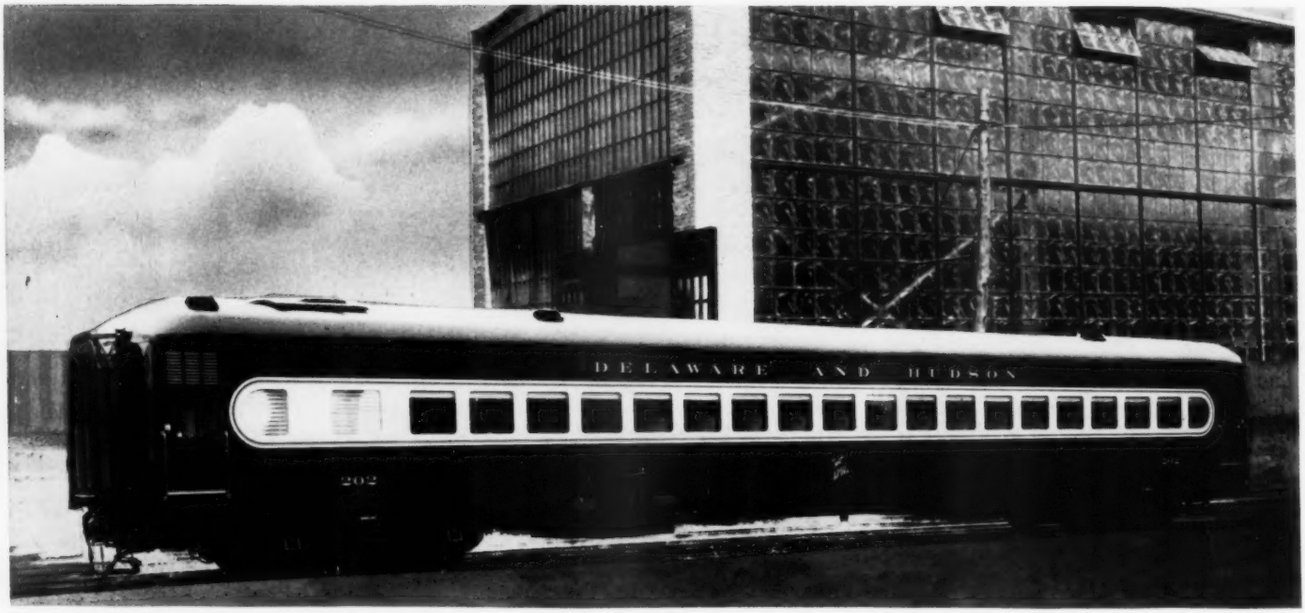
CONTINUOUS AUTOMATIC SPOT WELDING is made possible by adapting a weld timer to a seam-welder in order to accurately control length of time current is on and off, and to provide an automatic repeating cycle. A machine is now being used for series spot welding oil baffles to valve cover plates for engines. (45)

ATOMIC WELDING METHOD claimed to be satisfactory for light gages of stainless and low carbon steels and ferrous alloys has recently been made available, in which a liquid is brushed onto the metal at points where the welding is to take place, rod applied, and then subjected to heating. (46)

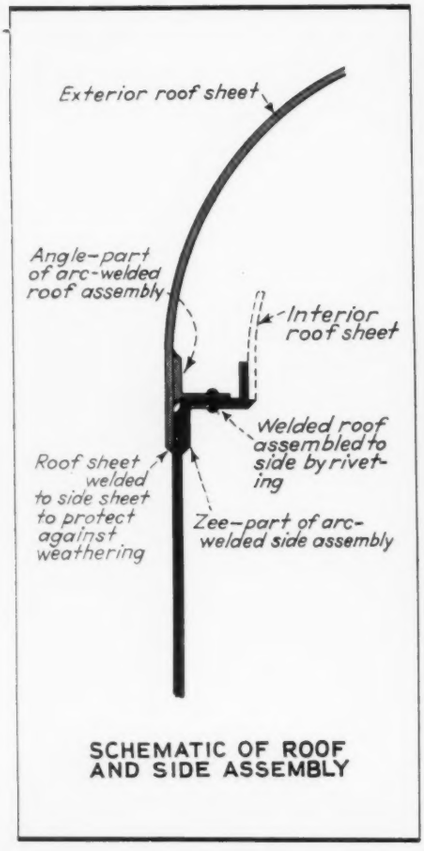
ZINC DIE-CAST PARTS are now subsequently cold formed to secure hollow shapes or sections such as door knobs, door pulls, and hand wheels. *For details of this process see coming January number.* (47)

Many other types of construction are described in this number, for other references see page 4 for itemized index.

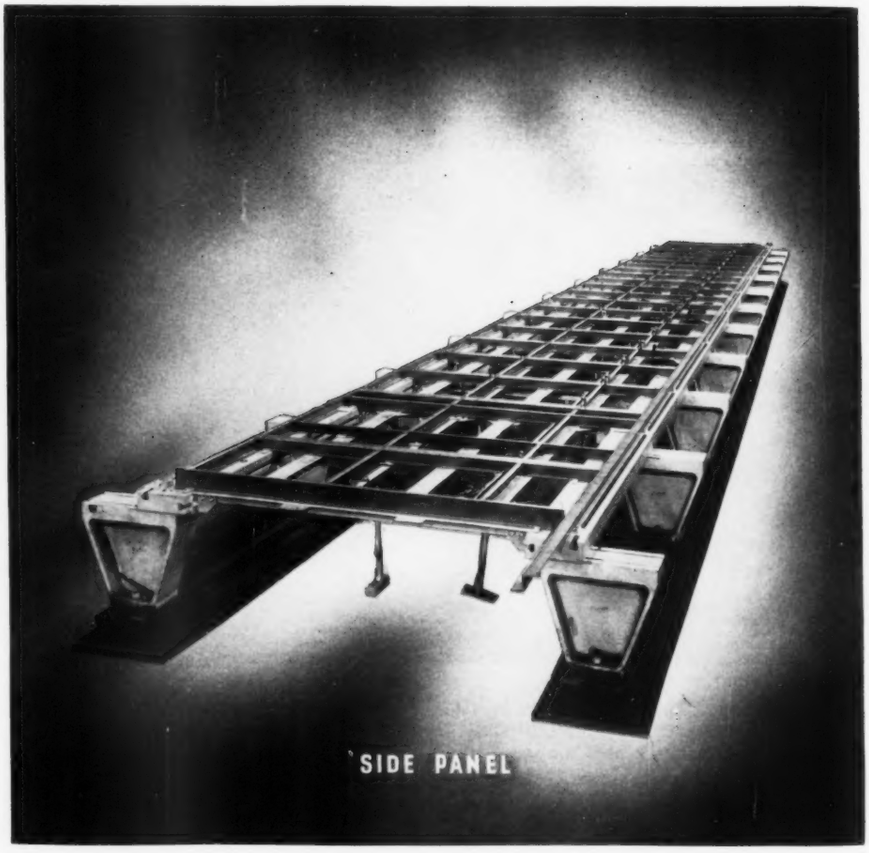
# Welded Sub-Assemblies Riveted Together




**New coaches** developed for the Delaware and Hudson Railroad are almost entirely of welded construction. Underframe, sides and top are assembled from structural steel parts arc-welded on jigs and the sheets fastened on by spot-welding, using a specially-designed semi-automatic machine. The four sub-assemblies are then riveted together. This construction permits replacement of side, top or frame and reduces maintenance expense since any sub-assembly can be removed without the necessity of taking apart entire car frame. Overlapping roof sheets are seal-welded to side sheets. Car was designed and built by the American Car & Foundry Company, and was styled by Raymond Loewy. Coach exterior is painted dark green; windows are framed in gray panel, that runs the entire length of car.


Exterior roof sheet
Angle—part of arc-welded roof assembly
Interior roof sheet
Welded roof assembled to side by riveting
Roof sheet welded to side sheet to protect against weathering
Zee—part of arc-welded side assembly

SCHEMATIC OF ROOF AND SIDE ASSEMBLY



**Arc-welded underframe** and assembled car frame, showing insulation in place. The only riveting used in car construction is that required to join roof section to sides and sides to underframe. Compressor and condenser are located under frame.

**Three alternate color schemes** have been devised for the coach interiors; the four front and rear seats are given contrasting color treatment. General indirect lighting is supplemented by individual lights over each seat. Basket racks are satin-finish aluminum; window capping is black Micarta. A dehydrating unit, consisting of a small cylinder filled with an activated alumina compound is placed between window panes to absorb condensation. Upon saturation, material turns white. Cylinder is then removed, the water driven off and unit replaced.

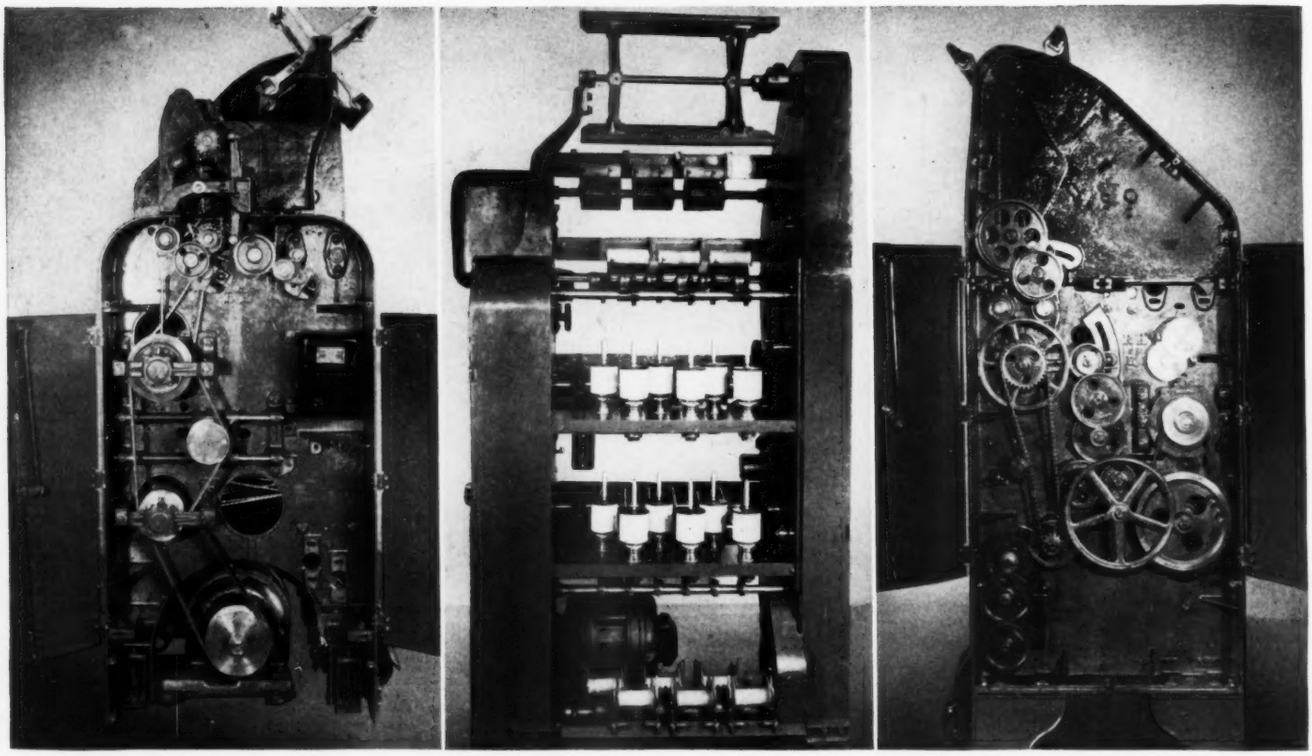
## Progress in Aviation

IN AIRCRAFT ENGINE DESIGN, the horsepower per cu. in. of displacement has been doubled over the past six years. A nine-cylinder Cyclone engine of six years ago developed 550 hp.; today, with the same displacement, the Cyclone develops 1,100 hp. Compression ratios have been increased to 7 to 1. These high compression ratios were made possible by the improvements in air cooling, better alloy steels, better aluminum alloy heads, and better fuels. The latest trend is from a cast head to a forged head, completely machined, having fins on the cylinder heads cut in instead of cast. The British have done this already. Engines of 2,000 and 2,400 hp. are being tested.

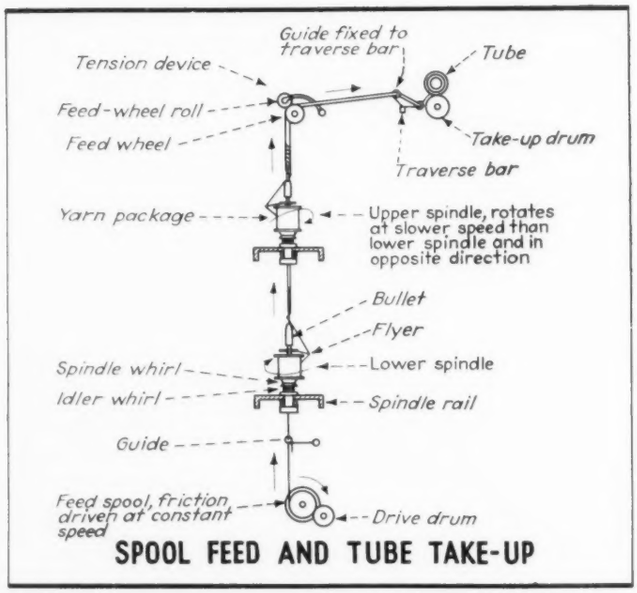
Independently driven electric generators, driven by a four-cylinder engine, generate 110 volt a.c. at 800 cycles. This has made possible lighter weight wiring and motors and the elimination of storage batteries. Total weight saved is more than the weight of the generator unit.

Sealed supercharged cabins for high altitude flying are in the Boeing 307 which is the first commercial ship to maintain at altitudes up to 20,000 ft. the normal pressure existing at altitudes of 7,000 to 8,000 feet. Pressure is maintained by automatically controlled blower.

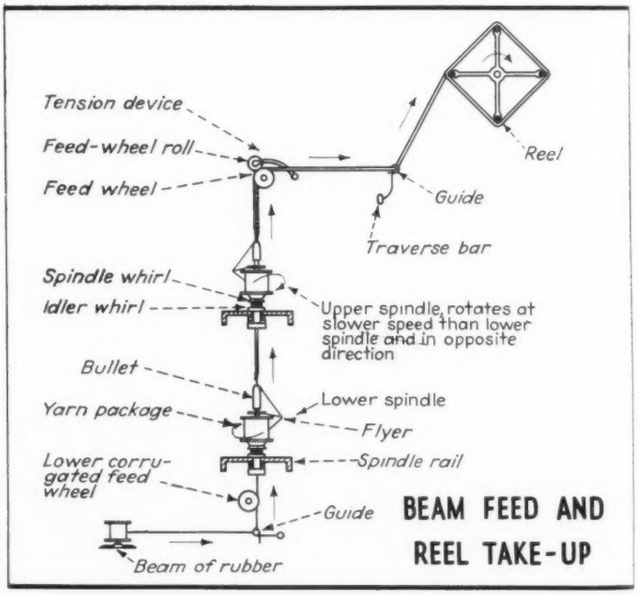
# Constant-Control Rubber Yarn Covering Machine



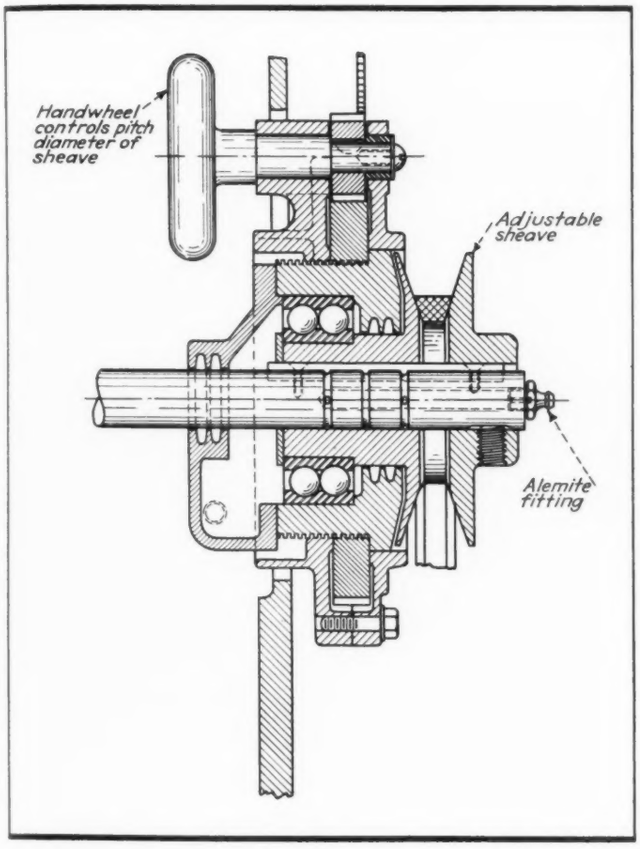
**Purpose of machine** is to wind cotton yarn in opposite directions about a rubber core so that the finished covered yarn will be in perfect balance. This machine is the result of several years of development by the H & B Machine Company research organization and is the most advanced in its field. It is single sided with 40 deliveries. Machine will cover light or heavy rubber; either beam or spool feed and either reel or tube take-up can be furnished. Head, foot ends, and intermediate samsons of the machine are of cast iron of extra heavy cross section to absorb vibration. Feet are adjustable by jack screws. Drive shafts are supported in ball bearings mounted on cast iron angle beams. The spindle rails are cast iron channels. All spur gears are cut with an extra wide face. All gearing is easily accessible.



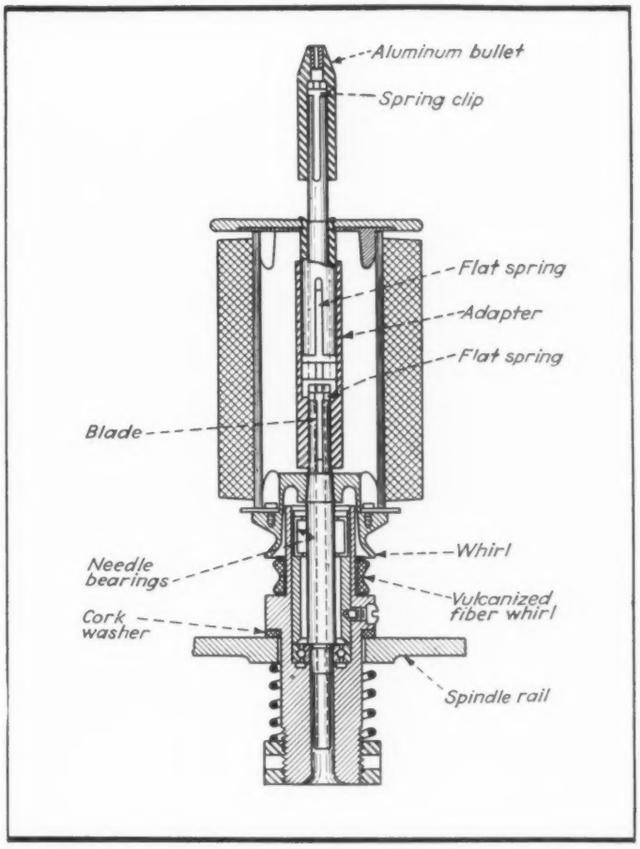

**Covering rubber thread,** shown schematically. Spool is held against the drive drum by spool guides whose center of gravity falls between spool axis and the drive drum. As the spool decreases in diameter, guide falls inward increasing pressure against drum to offset decrease in spool weight.



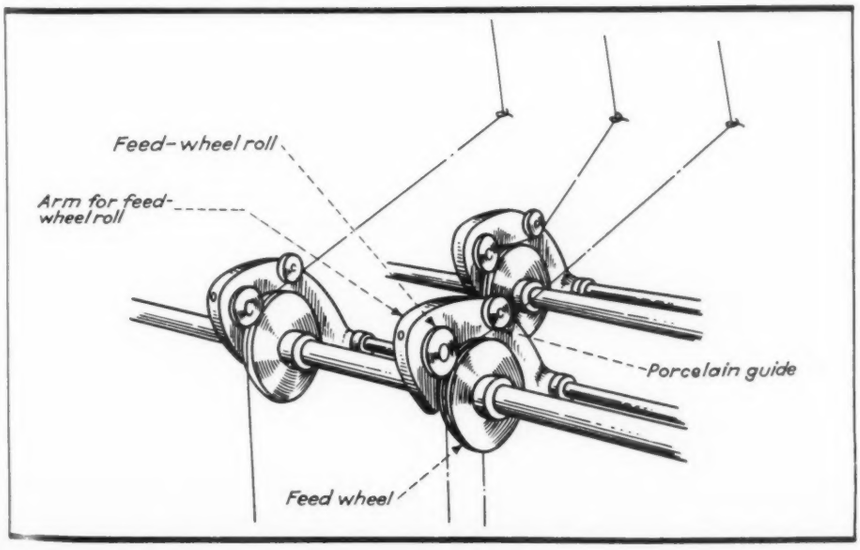

**Beam feed and reel take-up,** shown schematically. Rubber is fed from the beam by a positively driven lower corrugated wheel, and then fed upward through the spindle. Instead of being drawn up by the combination of a take-up drum and tube, it is wound on a revolving reel mounted on top of machine.




**Balanced, covered rubber yarn** for a specified elongation is obtained through the means of two variable speed drives. An Allis-Chalmers Vari-Pitch drive controls the speed of the upper spindles in such a manner that the rubber core with one wrapping of yarn about it, coming through the upper spindle, will receive the outer wrapping of yarn in the proper direction with the proper amount of twist. During the package run the diameter of the yarn package decreases, resulting in less yarn being removed from the package per revolution of the spindle. Under this condition an undesirable variation in yarn construction will be obtained. This condition is corrected by the H & B variable speed drive, by means of which at predetermined intervals, depending on the yarn construction, the speed of the upper spindles can be increased. Movement of the handle increases or decreases the pitch diameter of the sheave.




**Spindle,** designed to run at high speeds for various size packages, driven by an elastic belt, is cushioned by a cork washer and spring to eliminate shock and vibration caused by starting and by unbalanced packages. Blade is made from a special heat-treated steel. In the event of a rubber or yarn break, the elastic belt can be shifted from the whirl to the vulcanized fibre whirl to stop spindle. The tube of yarn is held at both ends by two flanges, each having four prongs. The two flanges are held together by friction created by flat springs bearing against the internal wall of the adapter. Drawing illustrates the method of holding a large package; for smaller packages, the adapter is removed and the hub is assembled to the blade. The aluminum bullet, held to the stud by a spring clip, can be removed for flyer changes. The bobbin flange is made of molded bakelite to insure a smooth serving edge for the yarn.




**Tension device,** which prevents slip of covered rubber yarn as it advances through the spindle to the reel or tube, consists of a grooved feed-wheel positively driven and a small weighted feed wheel roll which runs on the covered rubber yarn in the groove of the feed wheel. In threading, this device aids materially in speeding up the piecing-up operation and eliminates the old method of wrapping the yarn around two wheels.

**INCONEL because of its resistance to hot corrosive exhaust gases is used for exhaust manifolds and cabin heaters in the new clipper ships.**

DEVELOPMENTS IN MATERIALS AND PROCESSES FOR

# FINISHES AND PROTECTIVE COATINGS

IMPROVEMENTS made during the year in finishes make possible shorter production schedules with faster air-drying and baking enamels, new effects in enameled and electroplated surfaces, and several new corrosion proofing methods. Good paint adhesion can now be given to galvanized sheets by new processes which permit deep drawing after processing. Also, thinner coats of porcelain enamel are now available.

LOW-BAKE ENAMEL for industrial finishing now makes possible faster production in low-temperature ovens. The finish bakes in one-quarter hour at 250 deg. F., one-half hour at 225 deg. F., one hour at 200 deg. F., and two hours at 175 deg. F. (50)

FAST AIR DRYING finish recently announced gives good hiding with high gloss in one coat on smooth metal, and air dries hard overnight. Of the synthetic resin type, it sets in 20 min. and dries to the touch in 45 min. It is relatively elastic, and can be applied by spraying, dipping, or brushing. (51)

COLORS OF MANY METALS can be reproduced by a new baking enamel. Applied to any kind of polished metal by spraying or roller coating, the finish can be made to resemble brass, chemically treated aluminum and steel, and other colored metals. (52)

UNIFORM TWO-TONE EFFECT can be achieved in one spray application of a new baking metal finishing material which can be used on various gradings of metals, is easy to apply, and is unaffected by varying oven conditions. (53)

MAR-PROOF HAMMERED-EFFECT FINISH has been developed for use on rough or porous metals to cover defects in the metal, such as spot weld marks and file scratches. The finish, which can be baked on a short schedule, has good heat resistance, durability, and adhesion characteristics. While it has the effect of a rough finish, its surface is actually smooth and will not catch dust. (54)

ALUMINUM PAINTS for product finishing have been developed which will dry to the touch in 15 min. A ready-mixed nitrocellulose spraying lacquer has also been developed which will dry to touch in 5 to 10 min., and a lacquer is available which dries to the touch in ½ to 2 min. and dries hard in 3 to 5 min. (55)

WOOD FINISHING. A new development in wood finishing methods replaces three coats with one, applies one-half as much solids with all the body and fullness of the three-coat method, and reduces the time required for finishing from 20 hr. to 5 hr. or less. The new finish is applied by a special apparatus which maintains a temperature of just under 200 deg. F. at the nozzle of the spray gun. (56)

CORRONITE, the new metallic pore-free coating deposited by an easily controlled electroplating process to thickness of as little as 0.0004 in., has been found to give effective protection against corrosion. Objects coated by the new method can be welded and deep drawn. (57)

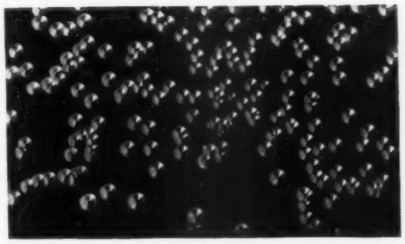
THINNER COATINGS OF PORCELAIN enamel developed during the year have greatly reduced possibilities of chipping and have increased resistance to shock. The new enamels give a 72 per cent reflectance with 34 grams per sq. ft. (58)

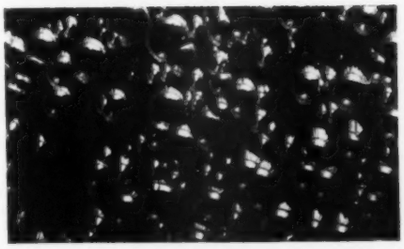
BLACK ELECTROPLATING. Producing a lustrous, deep black electro-deposit, a new process is based on a combination of molybdenum and nickel. (59)

For other references to finishes and protective coatings mentioned in this number see page 4 for itemized index.

**Opalescent enamel,** applied over the plastic housing of this radio, withstands severe abrasion and impact without marring or chipping. With this Sherwin-Williams enamel rich colors are possible using compounds which are cheaper than colored plastics

# Applications of New Finishes Improve Appearance



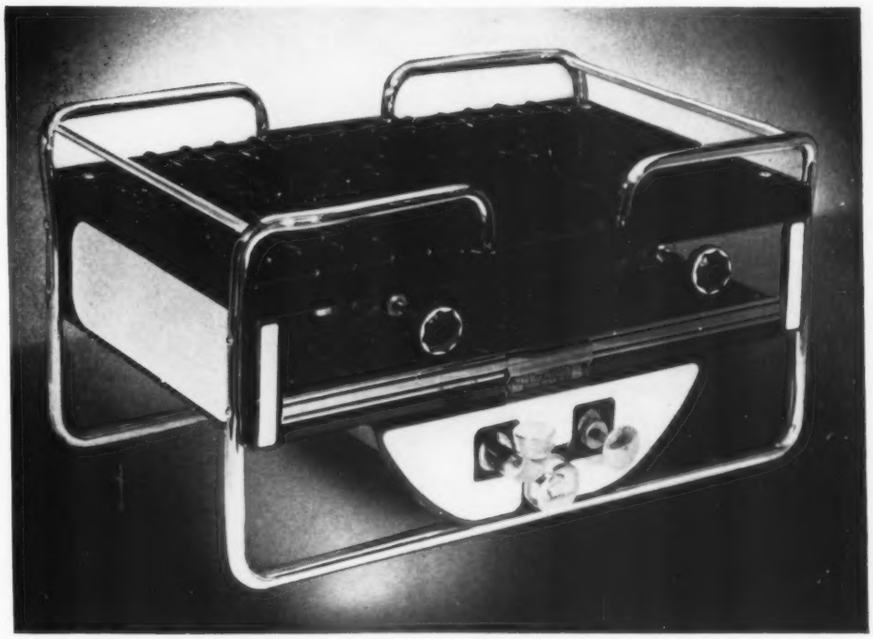


**Color plating** has advanced to the point where these positively-controlled patterns, including crackle, crystal, spangle, and dendrite designs can be plated over metals in a variety of colors. For further details of color plating see August, 1937, PRODUCT ENGINEERING.

SMOOTHNESS OF METAL or painted surfaces can be measured accurately by a device recently developed in the General Electric laboratories which is sensitive enough to indicate the difference in thickness of a finger-print on a piece of glass.

CHEMICAL PROCESS, which converts surface of machine part into a wear-resistant layer of iron and manganese phosphates, has been applied to piston rings, valve tappets, gears, crankshafts, and similar parts.

**Durable eye-appeal** is a feature of this Exact Weight scale. Housing and tower are of colored plastics, weight platter is chromium-plated brass, and confection scoop is polished nickel silver. Four-way dial is lighted for increased visibility from any direction. Weights, nested in plastic holder, are chromium-plated. Color combinations are available to harmonize with modern store interiors.



**Black and white porcelain enamel** and chromium-plated legs and guard rail lend a touch of sturdy smartness to this Willis galley stove, designed by Designers for Industry, Inc. Stove features positive quick-lighting burners, non-warping top grill and safety gage. Grease and dirt catching crevices are eliminated. Guard rail permits use of larger utensils and prevents their sliding in rough seas.

# SOME NEW MATERIALS AND RECENT IMPROVEMENTS IN ENGINEERING DEPARTMENT EQUIPMENT

THIS YEAR has seen the development of fatigue-reducing drafting machines and instruments, faster reproducing machines, and improved tracing papers and cloths. American machine-made drafting instruments recently announced are claimed to be an improvement on imported handmade instruments.

FREE-FLOATING FEATURE, achieved through new light-weight alloys, roller bearings, and precision construction, together with a method of gravity compensation which eliminates friction brakes and overhanging weights, serve to minimize drafting fatigue in new machines. (60)

COMPLETELY INCLOSED BANDS and working parts are featured by new drafting machines to minimize accumulation of dirt and to protect the draftsman. An improvement of equal importance is the full-vision protractor giving greater convenience of operation. A secondary 360-deg. protractor movement, operated by two thumbscrews, makes possible settings at any angle. (61)

STAINLESS STEEL for all principal parts and non-glare satin finish chromium plating for other parts have recently been adopted to produce drafting machines which will retain their fine appearance indefinitely. (62)

ADJUSTABLE BALL BEARINGS in a new low-price drafting machine are claimed to increase its accurate life. The machine makes drawings 24x36 in., is extremely rigid. It is equipped with protractor of the one-degree indicating type and a new kind of transparent edge, engine divided scales. (63)

PORTABLE DRAFTING MACHINES are now available in four sizes to take sheets from 9x12 in. to 15x20 in. Precision-made mechanism, consisting of steel arms with an oxidized finish, and protractor and scales with a flat silver finish, is mounted on light-weight, Masonite board. (64)

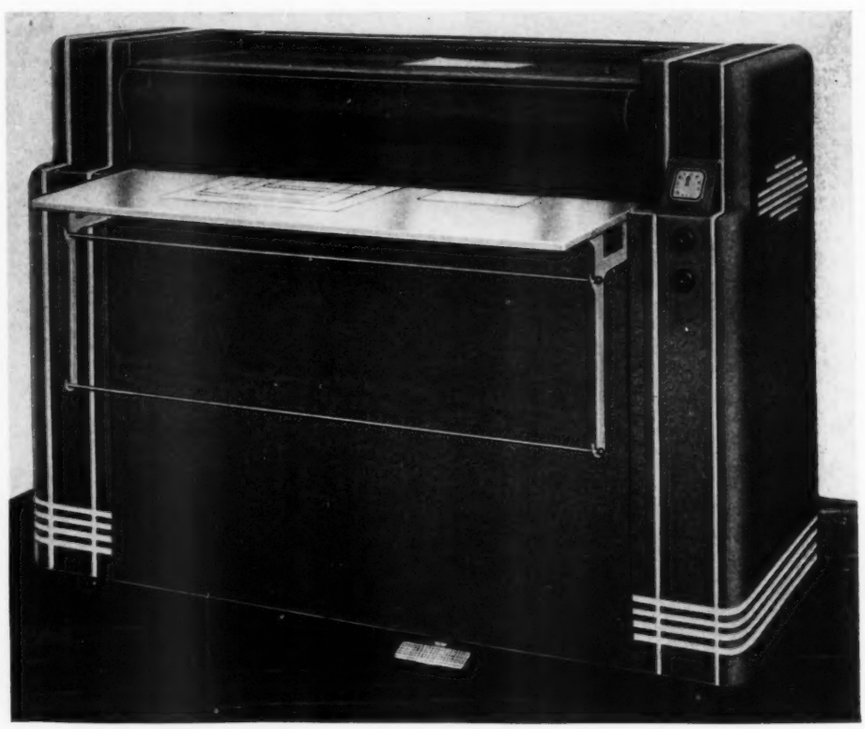
LETTERING SET designed for increased speed and uniformity, makes available 48 different weights and styles of type. Letters are formed in one continuous movement without shifting guide. (65)

TRACING PAPER treated with new synthetic transparentizing agent has high strength, will not oxidize, turn yellow, become brittle or lose transparency with age. (66)

NEW FINE WEAVE TRACING CLOTH with 180 threads per in. gives good transparency, provides maximum strength with minimum bulk, accepts the finest drawn detail, and endures repeated erasure. (67)

BLUEPRINT MACHINE utilizes patented arc lamps which can be operated at any one of three speeds. Tension wrinkles and distortion of the paper are eliminated in washing by floating the paper upon three water tanks. Nine aluminum drums dry the paper evenly and flatly. (68)

SMALL BLUEPRINT MACHINE, occupying desk space of 26x9 in., makes blueprints in any size up to 18x24 in. in one minute. Timer controls photoflood bulbs for proper exposure. (69)



**High pressure mercury vapor** quartz lamp, which not only provides faster printing speeds but also reduces current consumption, is a new development in this Bruning blueprint machine. Wattage of the tube can be reduced to about 50 per cent of normal by a control knob. Constant speed motor drives variable speed transmission to give controlled speeds ranging from 0 to 25 ft. per min. Synchronized pyrex cylinder and contact bands prevent slippage.

# SECRETS OR PATENTS?

## *Some Legal Aspects of the Question*

H. A. TOULMIN, JR.
*Toulmin & Toulmin*

THIS is too good for us to let our competitors know about. Let us keep it a secret and not patent it."

That simple statement is usually the beginning of more trouble than can be caused by any other executive decision. A good many concerns naturally want to keep their trade secrets, particularly as to methods of manufacture, away from their competitors. The law, however, has put so many very rigid requirements around the question of trade secrets that to secure any protection for your trade secrets is an extremely difficult thing.

Then, too, a great many concerns which rely upon trade secrets as their method of protection try to straddle the question by also filing applications for patents. This is an additional complication that makes matters worse because in the end they usually lose both the trade secret and also the patent. Here is the way that the situation works out.

When you undertake to keep some method or apparatus secret, the law says that you have to take every possible protection and precaution you can devise in order to maintain this particular thing a genuine secret, because if you do not, then the law says that you have not been diligent and it will give you no protection against one who may take the secret away from you. For instance, under the laws that now stand, it is necessary, in order to protect a trade secret, to put your employees under oath not to reveal the secret, to confine it to the fewest number of people possible in the plant, to have guards at the doors when the plant opens, to provide locks and chains when the factory is closed, and also to provide watchmen to prevent entry into the plant, and if necessary, to put any data in connection with the trade secret under lock and key.

If there is any carelessness on the part of the employees in carrying out these precautions, or if one of the employees should disclose the trade secret and you are unable to prove that he did disclose it, the courts would be in no position to help you and give you any protection. Furthermore, if you endeavor to restrain any person, firm or corporation from purloining your trade secret, it would almost be necessary to prove openly what it was in order to be able to get an injunction against its further use by the offending party. But then the cat would be out of the bag and the trade secrecy would be ruined because it would be a public disclosure.

It is true that in some instances, hearings in connection with restraining the publication of trade secrets are held *in camera*, but ordinarily, it is impossible to conduct a piece of litigation without making the secret public.

If it turns out that you have also filed an application for a patent, this automatically denies you any right to have your trade secret protected by the court. It is regarded as an election by you to pursue the protection of the patent laws rather than rely upon the protection of maintaining your secret by your own methods.

Again, to have a trade secret, you must be very sure that what you are maintaining as a secret is genuinely new and originated by you, and is not an old idea; for if it turns out to be an old idea and one that has been published either in a book or is known in a prior use at some other place, then it is no longer a secret and anyone can use it.

For instance, a few years ago a large chemical manufacturing company, which had developed a series of machines for the production of ultramarine blue, had maintained its process of manufacture and the nature of its machines as a trade secret, but it did not know that the author and designer of its apparatus had already secured the information from a very old book which he had utilized as the basis for creating and erecting the plant.

In the course of an effort by this company to stop a competitor from using this same apparatus, these facts came out, and the Court refused to give the first company any protection. It said that what was claimed to be a secret was not in effect a secret, but had already been published to the world at another place at another time. All the labor and expense, and risk and danger entailed in this matter by the first company went for naught.

In Macbeth-Evans Glass Company v. General Electric Company, 246 F. 695, the Court of Appeals for the Sixth Circuit had before it a case involving Macbeth's secret invention for making illuminating glass discovered and perfected prior to the fall of 1903. Plaintiff, for profit, made glass according to this secret formula and sold it as a regular article of trade for about ten years, or until it could no longer maintain the secret, before it obtained patent protection.

In 1910 an employee disclosed his knowledge of the secret process to a competitor of plaintiff, who then also manufactured glass according to this method, until legally enjoined. But details of the secret process were gradually divulged to others. In 1913, plaintiff, to protect itself against additional competitors and in an effort to thus extend its monopoly, applied through the inventor for a patent which it secured for this process; and then sued General Electric Company, who had come by its knowledge of the process honestly, as an infringer of this patent. The Court invalidated the patent, holding that plaintiff having elected to rely for nearly ten years upon its trade secret for protection, in effect waived its rights to secure patent protection and abandoned the invention to the public.

In the text of his opinion, Judge Warrington made these pertinent remarks:

"When Macbeth perfected his invention in 1903 he and his company evidently concluded to control and use it for purpose of profit, and to work out these ends by practicing the invention in secret and placing the product on public sale. The plain object of such a course was to exclude others from using the invention and to secure its benefits for themselves. The adoption of this course signified by necessary implication a belief that the nature of the invention would enable them in this way to protect it for a substantial period of time, if not for a longer time than could be secured under the patent laws. The result shows that their belief was justified for a period of nearly ten years. True, it is admitted and rightly that the inventor and his company adopted and pursued this plan with knowledge that the invention . . . furnished them no protection against use by others who might honestly discover it. This, however, inevitably concedes an intent either to abandon the right to secure protection under the patent laws, or to retain such right and if necessity should arise then to obtain through a patent a practical extension of any previous exclusive use (secured through secrecy) into a total period beyond the express limitation fixed by those laws. If the first of these hypotheses be the true one, it is not easy to see how the right to secure patent protection survived. The second hypothesis presents the two rights claimed and which it is said could not

both be retained because of their inconsistency."

". . . It is settled that when a choice of inconsistent rights is once made by a person having the right of election and also knowledge or means of knowledge of the essential facts, he is concluded by his action. Here the choice made was deliberate and is unmistakable; it was the secret use for profit and was persisted in for years. If the right to secure protection of the patent laws can be effectively repudiated, it certainly has been here."

A. O. Smith Corporation v. Petroleum Iron Works Company, 73 F. (2d) 533, involved a case in which the plaintiff was the owner of a number of secret processes useful in the field of electric arc welding. For some of these processes it had obtained patents. At the time of the trial, applications for patents had been filed on several more of these processes, which applications later matured into patents.

The defendant, through its superintendent, tried to get access to plaintiff's welding department to learn these secret processes, but was denied. It then engaged one of plaintiff's employees who was under an express contract not to divulge any information secured by him in his confidential relationship with plaintiff. Defendant then began practicing these processes. In an action against the defendant in the District Court, plaintiff secured a decree awarding it an accounting and damages for the appropriation of certain of these secret processes for the period between the time of the filing of the applications covering these processes and the issuance of the patents on them.

In an appeal, the defendant challenged this decree on the ground that the right to secrecy and the right to patent monopoly are inconsistent and cannot both be asserted for the same process at the same time. The Court of Appeals affirmed the decree of the lower court with the proviso that if "it should be found that additional patents have issued on any of the secret processes, the decree may be modified by dissolving the injunction with respect to them."

In Victor Talking Machine Company v. Starr Piano Company, 281 F. 60, the Court of Appeals for the Second Circuit had before it an infringement case in which it was contended that the Johnson patent in suit for a disk sound record for talking machines was invalid for abandonment. Plaintiff's explanation was that upon advice of counsel it had kept its Johnson process secret for some years before securing a patent because it was thought a patent for the invention would be invalid due to the existence of certain prior art patents. The court held that the maintenance of the process in secret amounted to a clear abandonment of the right to secure patent protection, and so held the Johnson patent invalid.

Another instance of how a trade secret may be lost is shown in the case of Grasselli Chemical Company v. National Aniline & Chemical Company, 282 F. 379, in which the District Court in New York ruled that the plaintiff had a right to compel the defendant to answer questions as to whether defendant used certain elements of the claims of plaintiff's two patented processes, which did not constitute the whole process. Defendant urged that in answering such questions it would have to reveal its own secret process. Nevertheless the Court compelled defendant to answer holding that plaintiff's right to ascertain whether defendant was infringing must prevail over defendant's right to preserve its process in secrecy.

The difficulties of protecting trade secrets are numerous. The courts are inclined to require a manufacturer who relies upon a trade secret to prove that he has taken every possible precaution to keep the idea secret. If a manufacturer elects to keep a new development secret, then he abandons all rights to a patent on it. This does not mean, however, that just because a development is kept secret while awaiting the filing of a patent application, there is any abandonment of the invention. It only means that if it is kept secret by a manufacturer over a greater period than permitted by law within which to file an application, then this is presumed to be an abandonment of the right to rely upon a patent.

In short, trade secrets are difficult and dangerous things to handle.

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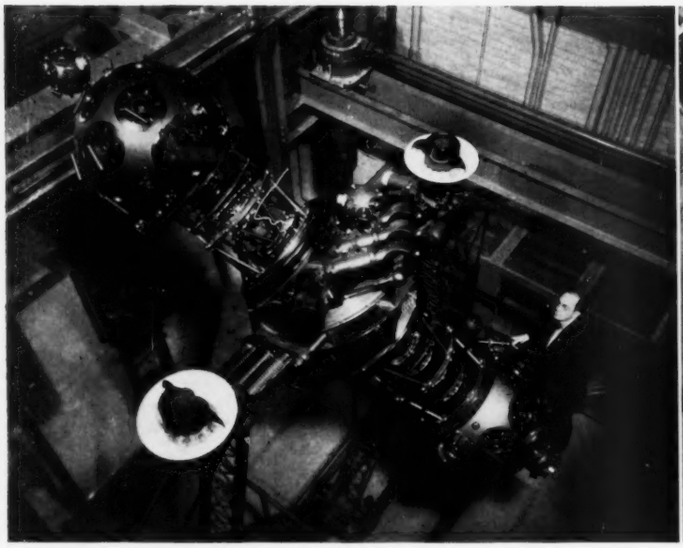
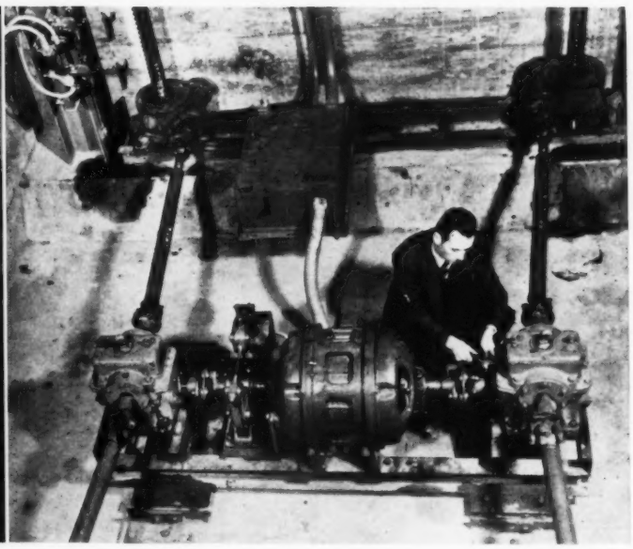
# Projector Rises From Basement in New Planetarium





**Unique lifting device,** installed in Pittsburgh's new Buhl Planetarium, causes middle section of the auditorium floor to lower and slide under the basement ceiling, and raises the $134,000 star and planet projector into place. Two motors with a combined output of about 9 hp. are so geared that they can raise, lower and slide the 3-ton floor which normally rests above the projector. By means of universal joints and four screw gears, the 20-hp. motor shown at right raises and lowers the 4½-ton platform upon which is supported the 3-ton projector and frame. Collision between the valuable rising projector and the disappearing floor is prevented by interlocked safety switches.

# CAPACITOR MOTORS—II

## *Performance Characteristics of Standard Types*

T. C. LLOYD
*Chief Engineer, Robbins and Myers, Inc.*

SEVERAL different schemes are employed to overcome the low starting torque of the permanently split capacitor motors by using two values of capacity, one for starting and one for running. Any method which would connect a high capacity condenser in series with the starting or auxiliary winding, and then remove it when the motor reached about two-thirds of its final speed, would offer the previously mentioned advantages of high starting torque with low starting current. (See Part I, *Product Engineering*, November, 1939, p. 489.) If this auxiliary winding is not disconnected from the circuit, but operates through a running condenser, then all the advantages of "smoother" operation, high power factor and efficiency, and reduced motor noise, are obtained for running.

One obvious plan for obtaining these dual advantages is shown by the connecting diagram of Fig. 3. Two condensers are necessary, obviously adding to the motor bulk. A centrifugal switch must also be used.

A second plan uses one condenser, but varies its effectiveness by means of a transformer. Doubling the voltage on a condenser by a transformer makes it four times as effective; tripling the voltage makes it nine times as effective. The disadvantage lies in the fact that the condenser must be designed to operate successfully for the high voltage. This slightly increases bulk and cost. As the same condenser is to be used for running as well as starting, it must be good for continuous operation, hence the oil type is required.

Note the diagram of Fig. 4. The transformer used is of the "auto transformer" type having one winding. If the starting lead is a mid-tap in the winding, then the voltage across the whole winding (and the condenser) is double that from *A* to *B*. Hence with the switch on mid-tap the apparent capacity of this condenser is 40 mfd.; with the switch on the running position, the condenser obtains only its usual voltage, and the motor operates with 10 mfd. of condenser in its auxiliary winding. For the purpose of illustration the transformer was assumed to be mid-tapped and a ratio of 4 to 1 was obtained between starting and running capacities. Actually the transformer can be tapped at any position suiting the desired running and starting conditions, limited only by the voltage desirable for the condenser. Also the switch, transferring from "start" to "run" can be the centrifugal type or a manual starter can be used. The latter is preferable for the larger ratings.

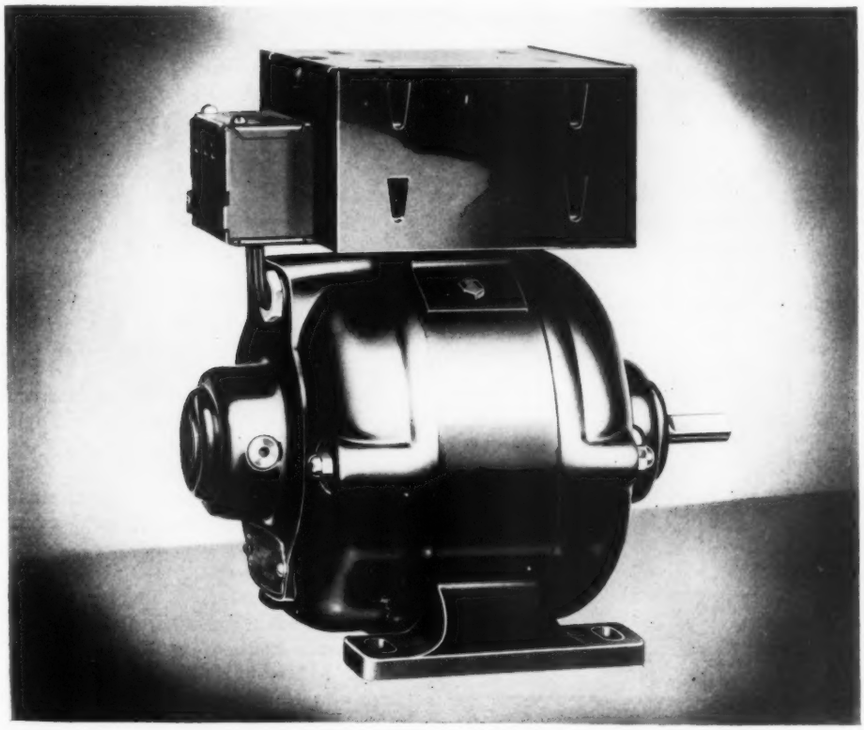


*Fig. 2—Permanent split capacitor motor that uses an oil capacitor*

Single-phase induction motors are essentially constant speed devices, the speed being fixed by the frequency and the number of poles for which the stator winding is constructed. Yet because of the need for variable or multi-speed motors a number of methods have been developed for accomplishing such results.

The multi-speed motor duplicates the stator windings of the ordinary type, resulting in two different speeds. Thus if a 60-cycle motor is supplied with a four-pole winding resulting in a full-load speed of 1,725 r.p.m., the addition of a second winding (both main and auxiliary) for six poles, will make a speed of about 1,140 r.p.m. available. No nicety of adjustment is possible, the motor must run definitely on either one or the other speed. Or, if three speeds are desired three sets of windings can be provided. This plan, used on some polyphase motors as well as single-phase, is applicable to most of the capacitor motors as well.

Thus the capacitor-start motor can be connected as shown in Fig. 5, utilizing the same condenser for both windings. Or the permanent split capacitor motor in its simplest form is similarly adaptable as shown in Fig. 6. In any case, motor bulk is increased in order to provide for more winding space and motor costs are also raised.

Permanent split capacitor motors, besides being available in multi-speed design, are also useful for variable speed. Such construction has a number of drawbacks, which should be understood. A motor can be made to operate at reduced speed if it is so weakened that it is unable to operate at the speed it would normally have at full load. Thus a 1,725 r.p.m. motor, by doubling its load, might be made to operate at, say, 1,450 r.p.m. Such a motor would overheat. But if weakened by voltage reduction, the normal load will have the effect described above, giving a reduced speed. Reduction of load causes the speed to increase. Then for general purpose applications such a plan is not very useful as it means that with every load change there will be a

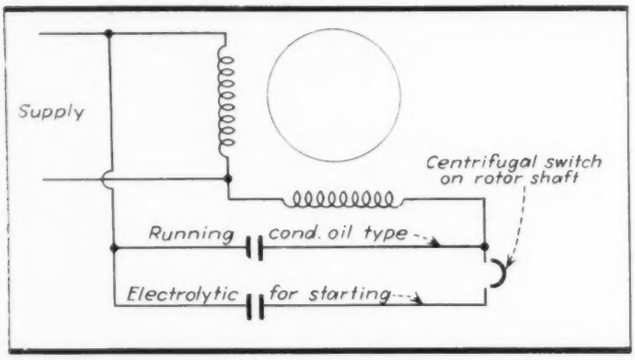



*Fig. 3—Double value capacitor motor with centrifugal switch that permits the electrolytic condenser to be in circuit only long enough to produce good starting torque*

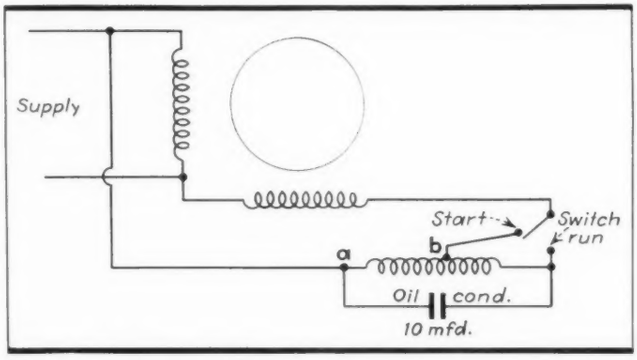



*Fig. 4—The effects of high capacity for starting and of low capacity for effective running operation are obtained in this design by varying the voltage across the condenser*

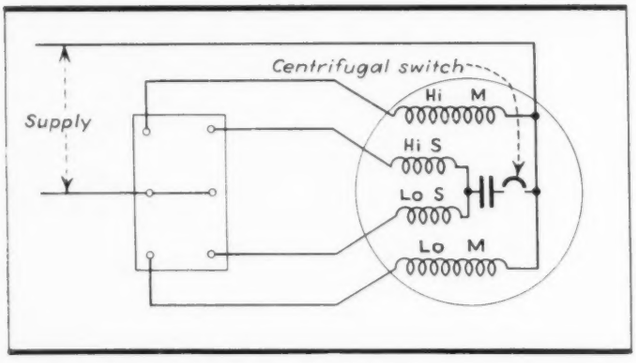



*Fig. 5—Two-speed type capacitor start motor with connections for double-pole double-throw switch*

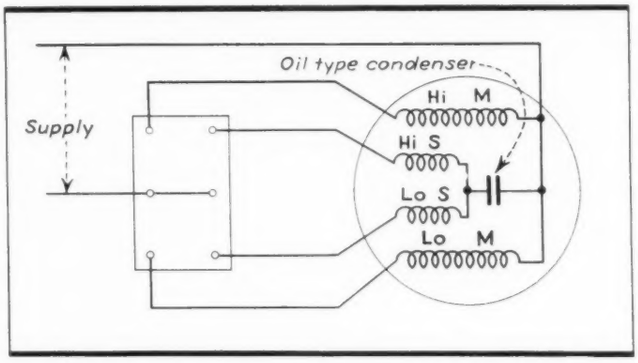



*Fig. 6—Capacitor motor for two speeds that operates with the same oil type condenser on each*

speed change as well. Yet for fans or blowers, the relationship between speed and power required is fixed; hence reducing the voltage a definite amount to obtain a weaker motor always gives a definitely lower speed.

Variable voltage sources are not always available and so the motor voltage is usually controlled by means of a transformer or auto-transformer with various taps. A still different method is shown in Fig. 7. The main winding is of two equal parts, normally paralleled as shown in (*A*). If designed for 110 volts, then each winding has 110 volts impressed on it. Connecting the two main windings in series reduces the applied voltage on each to 55 volts, greatly reducing the power available from this winding. The condenser circuit, connected across the 110-volt line constantly, is unaffected. The weakened motor (with fields in series) usually operates at about 60 to 70 per cent of its normal speed, when operating a fan. If no load is connected to its shaft the speed with either connection is practically the same. This scheme, like many others for speed control, is fully covered by patent.

Reduction of speed by voltage control is also accomplished by auto-transformers tapped so as to vary the voltage across either the main winding, the auxiliary winding, or both. Two such schemes are shown in Figs. 8 and 9. Regardless of the final speed setting on any of these plans, the removal of load results in an increase in speed to about normal value. Fifty per cent speed reduction is about the limit of practicality and starting torque (because of the permanent split capacitor effect) is always low.

Out of all the methods of utilizing condensers with single-phase motors, only the various forms of permanent split connection influence motor noise.

All motor noise arises from vibration. The source may be purely mechanical. Others are electrical in origin. The number of rotor and stator slots per pole are of prime importance in determining the motor noise as is also the distribution of the windings. Eccentric air gaps may result in noisy motors. Yet when the motor is mechanically correct, and the punchings are uniform and symmetrical and the winding distribution has been

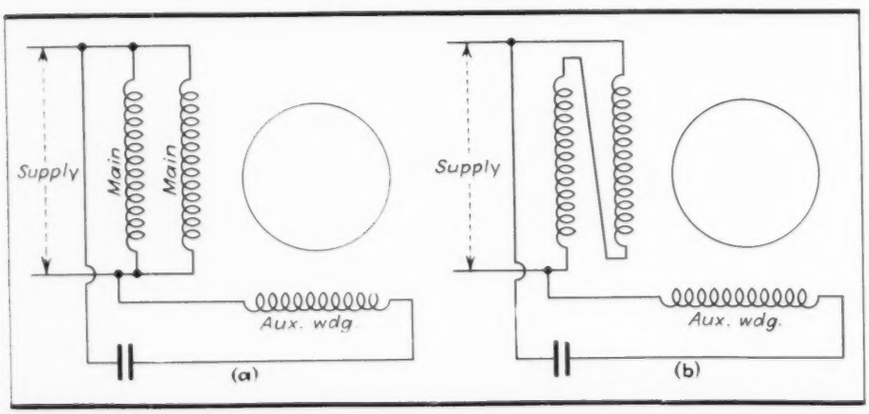



*Fig. 7—Method of speed control by series-parallel connection of the main winding. The parallel connection (A) is for high speed. This connection is covered by patent*

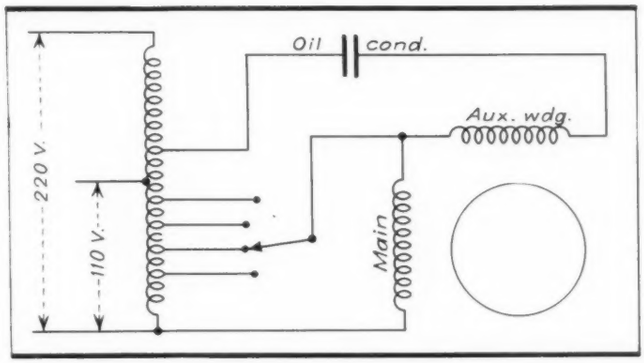



*Fig. 8—One method (patented) of controlling speed of capacitor motor. The auto-transformer for speed control is also useful for applying motor to either 110- or 220-volt circuits*

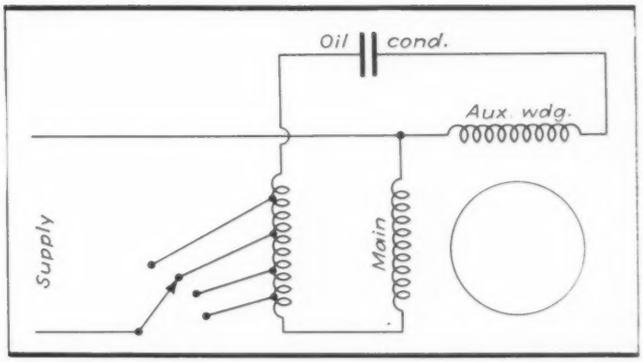



*Fig. 9—Another method for using a small auto-transformer to control speed of motor. This system of making connections is also covered by patents*

wisely chosen, a great source of single-phase motor noise still exists. This is the double frequency vibration inherent with single-phase motor action. It must be recalled that a single phase motor with only its main stator winding builds up a pulsating magnetic field only. On 60-cycle supply this flux pulsates 120 times per sec. Once the motor is running the reactions of the rotor and stator produce more or less of a rotating magnetic field, never as uniform as a polyphase machine could give. This irregular magnetic action produces a pulsation, to which the teeth of the punchings or other mechanical parts may respond. The source is always present, but the response to this pulsation and the resulting noise may be more or less in some designs.

The use of an auxiliary winding with a permanently connected condenser in the circuit changes this condition. Because such a motor approaches a two-phase machine in operation, the magnetic pulsations may be greatly reduced. Theoretically, a uniformly rotating magnetic field is possible with a particular load, but in practice the permanently split capacitor still gives some double-frequency pulsation. Yet in most cases the reduction of a few noise units can always be obtained by the use of a condenser as against the split-phase or condenser start motor.

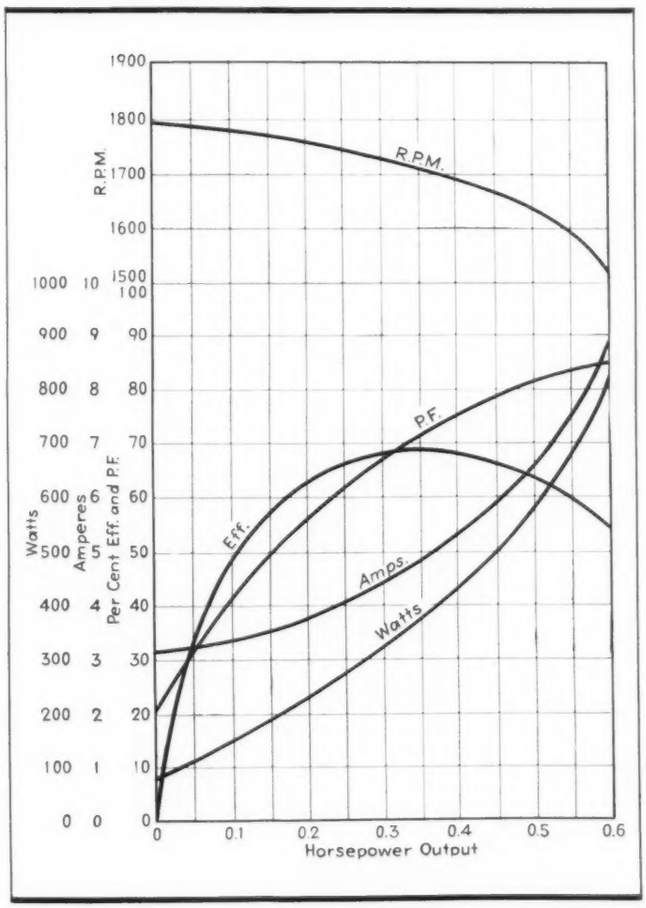



*Fig. 10—Curves for a double value capacitor motor. Electrolytic starting capacitor results in good starting torque. Oil capacitor used for running gives a slight increase in maximum torque, better efficiency and power factor, and quieter operation*

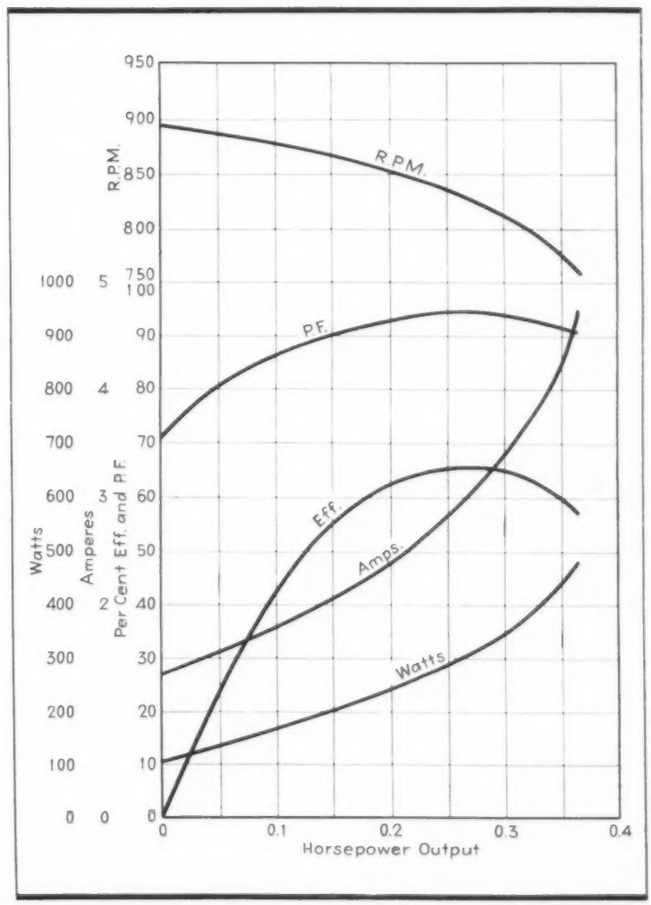



*Fig. 11—Slow speed motor for fan duty, ¼ hp. This is a permanent-split capacitor motor using an oil condenser large enough to give unusually high power factor. The starting torque of 10.7 oz.-ft. is less than half of the full load torque*

# PHOTOELASTIC ANALYSIS

## *Of Stress Distribution in a Pin and Plate Joint*

ARSHAG G. SOLAKIAN
*Polarized Light and Photoelastic Company*

TO JUSTIFY a photoelastic study, a pin and plate connection should be strictly a two-dimensional problem, obviously such a connection represents the conditions present in a multiply connected plate acted upon by an isolated force over a limited surface of the hole. However, an analytical solution by E. G. Coker and L. N. G. Filon, presented in their book "A Treatise on Photoelasticity," Cambridge University Press, 1931, shows that the effect of the elastic constants involved in the expressions for stresses is not of such character as to alter the stress distribution obtained experimentally for two different elastic materials. Therefore, the results described in this article which were obtained by using polarized light and a model made from a transparent material, can be safely accepted for the design of similar structures of steel or other materials.

In the investigation described here a 4 in. wide plate was used which had a 1½ in. hole located at a distance of 1⅝ in. from the free end and on an axial line. A comparative study of three pin-and-hole conditions with different clearances was made. The distribution of principal stresses for these three conditions were investigated for the following most important sections: (*a*) the boundary of the hole, (*b*) a diametrical section perpendicular to the applied force, and (*c*) a diametrical section parallel to the applied force and directly under it. Since the upper part of the section was only lightly stressed it was disregarded.

The model consisted of a 0.354 in. thick plate of photoelastic Bakelite with polished surfaces and having a fringe-stress value of about 88 lb. per sq.in. Three cylindrical pins made of the same material and having diameters respectively 1.500, 1.492 and 1.469 in. were used in the tests, giving clearances of O in., 1/124 in., and 1/32 in. A total force of 600 lb. was used in all the tests, applied symmetrically on the two ends of the pin through a loading arrangement as shown in Fig. 1. The portions of the pin projecting out of the plate on either side were reduced to about ¾ in. in diameter in order to facilitate the use of a lateral extensometer for points close to the boundary of hole, and also to safeguard the hole surface from the thrust effect of localized heavy deformation of the pin portion directly under the applied force.

A complete study of a stress problem requires the determination of both the directions and intensities of the principal stresses $\sigma_1$ and $\sigma_2$ at various points in the stress field. The directions of these stresses are obtained from a set of curves called isoclinics, which are known to be the loci of the principal stresses of constant orientation throughout their path. These curves actually are the axes of black bands produced optically with plane polarized white light, for various angular orientations of the crossed

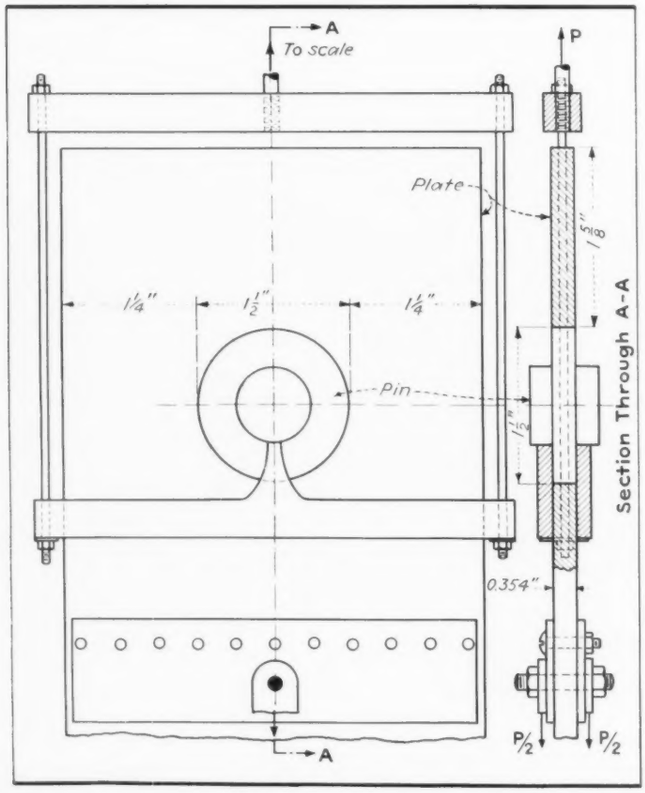



*Fig. 1—Arrangement for loading pin and plate under test. The load is applied symmetrically on the ends of the pin*

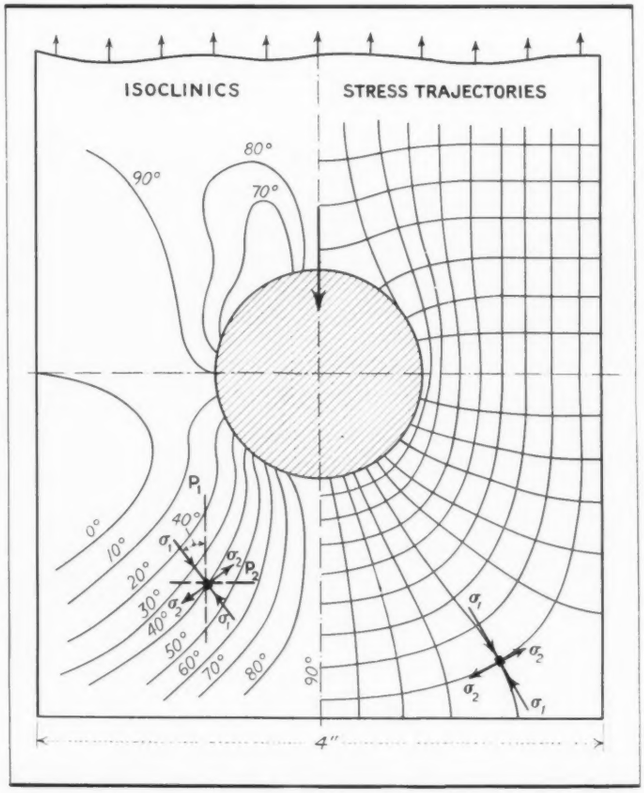



*Fig. 2—Isoclinics of 0 deg. to 90 deg. in increments of 10 deg. and principal stress trajectories set up in plate by load on pin*

prisms in a polariscope. Isoclinics from 0 up to 90 deg. in increments of 10 deg. for the problem investigated are shown in the left-hand side of Fig. 2. It was found that for the three clearance conditions, these curves were identically similar. From these the directions of the $\sigma_1$ and $\sigma_2$ stresses are traced graphically, as shown in the right-hand side of Fig. 2 by the stress trajectories.

The intensities of the principal stresses are obtained by a combined optico-mechanical method, giving the values of the difference $(\sigma_1 - \sigma_2)$ and the sum $(\sigma_1 + \sigma_2)$ of the principal stresses. The first are obtained from interference fringe patterns while the latter are obtained from observations of the change of thickness $\Delta t$ of the model during the loading and unloading process.

For the applied load of 600 lb. total (equivalent to a uniform stress of 452 lb. per sq. in. at the loaded end of the plate) the stress patterns for the three different conditions of clearance are given in Figs. 3, 4 and 5, as obtained with circularly polarized monochromatic light.

From the well-known principles of photoelasticity, each fringe line in these pictures represents a constant value of $(\sigma_1 - \sigma_2)$ stress all along its axis. For the test plate having a thickness of 0.354 in. the $(\sigma_1 - \sigma_2)$ stress equivalents of 0, 1st, 2nd . . . $n$th fringes are $0 \times 248$, $2 \times 248$. . . . $n \times 248$ lb. per sq. in. where $n$ is the order of the fringe considered, as marked in the fringe patterns of Figs. 3, 4 and 5 for convenience. From these pictures the distribution of the $(\sigma_1 - \sigma_2)$ stresses are obtained for the three sections considered and represented graphically in Figs. 6 and 7. Since the maximum shear stress is known to be equal to one half the numerical value of the $(\sigma_1 - \sigma_2)$ stress at a point and on planes at an angle of 45 deg. with those of the principal stresses, therefore, Figs. 2, 3, 4 and 5 are useful in the study of the variation of these maximum shear stresses on the sections considered.

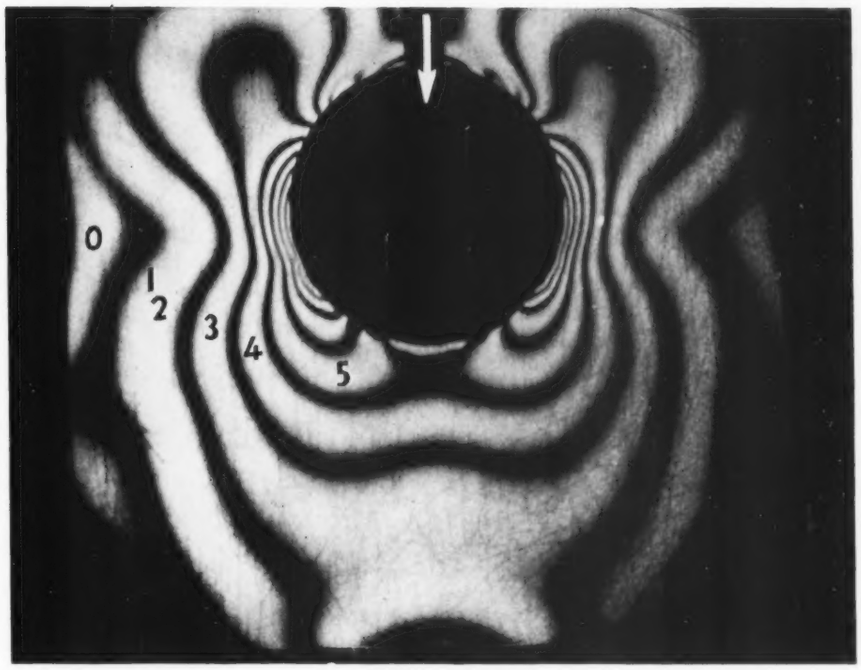



*Fig. 4—Stress pattern for plate with 1/128 in. clearance at pin connection*

The mechanical arrangement for measuring $\Delta t$ by means of Coker's lateral extensometer is shown in Fig. 8. The curves showing the distribution of the $(\sigma_1 + \sigma_2)$ stresses for the three sections considered are given in Figs. 6 and 7. The values of $(\sigma_1 + \sigma_2)$ stresses are computed from those of $\Delta t$, by the well-known expression

$$\Delta t = \frac{m}{E}(\sigma_1 + \sigma_2)\, t \text{ or } k\,(\sigma_1 + \sigma_2)$$

where $m$ is the Poisson's ratio, $E$ the modulus of elasticity and $t$ the thickness of the plate used, all being constant and their combination $\frac{m}{E}\, t$ being taken as $k$. The curves in Figs. 6 and 7 give therefore a picture of the variation of change of thickness along a section caused by the applied force on the model.

Having determined the values of $(\sigma_1 - \sigma_2)$ and $(\sigma_1 + \sigma_2)$ stresses as to both sign and numerical value, then the individual values of the $\sigma_1$ and $\sigma_2$ stresses are obtained easily by computation. Their variation over the three sections considered are shown graphically in Fig. 9. The total applied force of 600 lb. produces an average stress of 675 lb. per sq. in. across a diametrical section through the hole, perpendicular to the applied force. As a check on the accuracy of the experimental results, the mean ordinates of the $\sigma_1$ stress curves shown in Fig. 9 for the three clearance conditions of testing are found to differ from the applied stress values by not more than plus or minus 3 per cent.

The $\sigma_1$ stress is found to be all tension on the horizontal section except where the clearance is $\frac{1}{2}$ in., where a very small compressive stress is acting at the outer edges of the plate, part of which (if not all) may have been caused by the "aging" of the model after it was

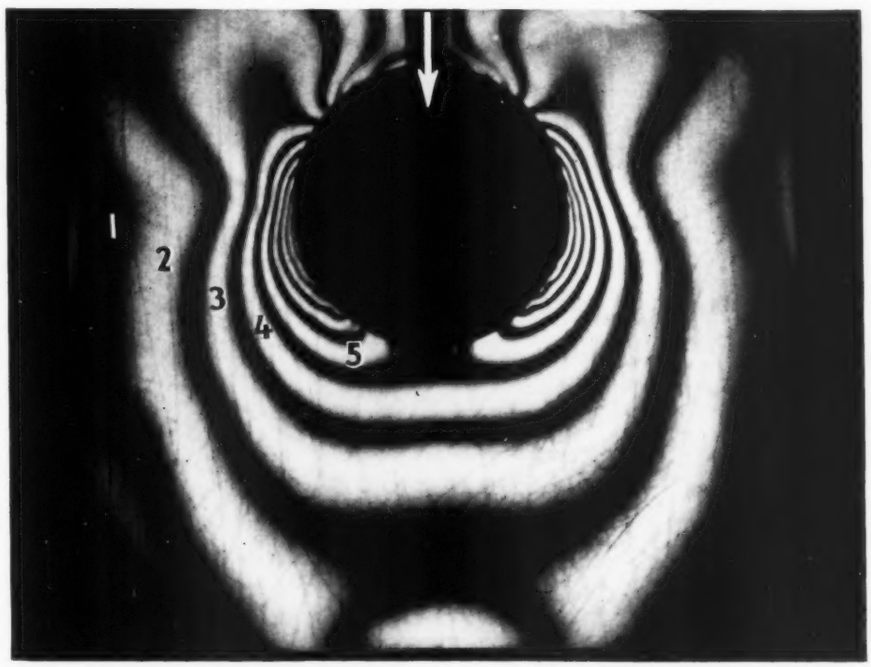



*Fig. 3—Stress pattern for plate with no clearance at pin connection*

made and tested for the two previous conditions, as is also easily observed in the $\sigma_1$ curve of Fig. 9 for the vertical section and

$(\sigma_1 - \sigma_2)$ and $(\sigma_2 + \sigma_2)$

curves for the same section in Fig. 6. The highest intensity of the $\sigma_1$ stress on the horizontal section is at a point on the boundary of the hole and is about 2.55 times larger than the applied stress for the 0 in. clearance condition and about 2.82 times larger for the other two conditions of clearance.

On the vertical section (parallel to the applied force) the $\sigma_1$ stress is tension all along the section increasing gradually in intensity from the hole towards the free end of the plate (the direction of this stress is at right angles to the applied force).

Along the boundary of the hole, the $\sigma_1$ stress is tangential in direction and increases in intensity from a minimum tensile value of about 250 lb. per sq.in. to about 1,850 (for no clearance) and 1,950 (for the other two clearances) lb. per sq.in. tension, then after reaching a zero value at a point close to the applied force, attains a maximum compressive value of about 350 lb. per sq.in. at the upper end of diameter of the hole. It is interesting to observe that the maximum $\sigma_1$ stress on the boundary of hole is not on a horizontal diametrical line, but 15 to 20 deg. below, towards the force.

The $\sigma_2$ stress is all tension on the horizontal section, except when the pin has no clearance, which seems to exert a considerable thrust against the surface of the hole, caused by the deformation of the latter under the applied load. On the vertical section, the $\sigma_1$ stresses are of a compressive nature throughout and are of maximum intensity directly under the load, reducing to zero at the free end of the plate. Along the boundary of the hole these stresses are radial and compressive, and have their highest intensity again directly under the load, reducing to zero at points on

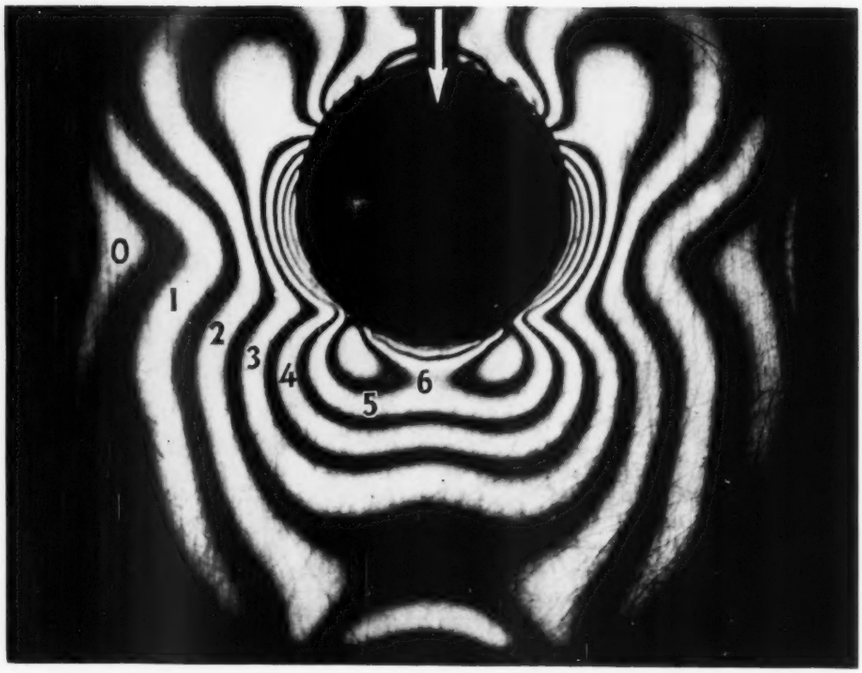



*Fig. 5—Stress pattern for plate with 1/32 in. clearance at pin connection*

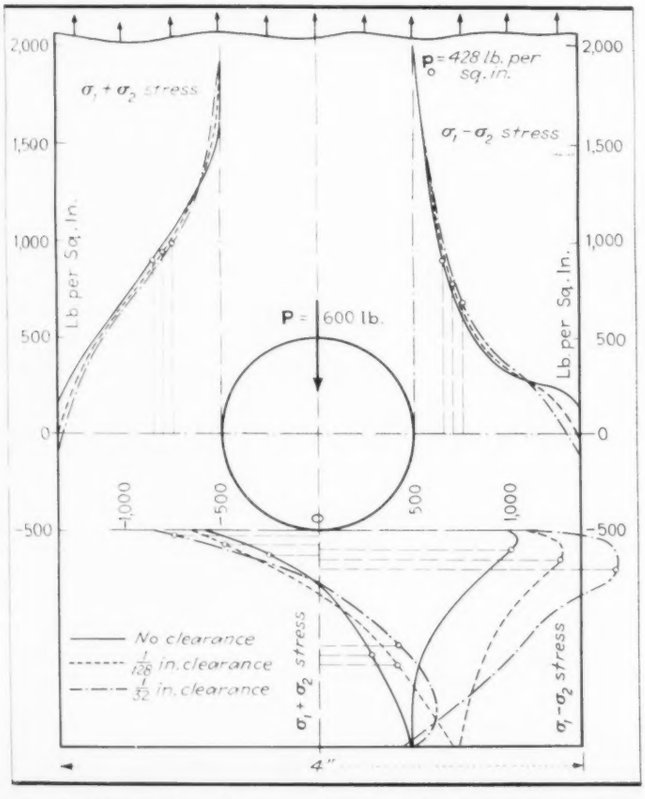



*Fig. 6—Distribution of $(\sigma_1 - \sigma_2)$ and $(\sigma_1 + \sigma_2)$ stresses in plate with three different conditions of clearances in plate*

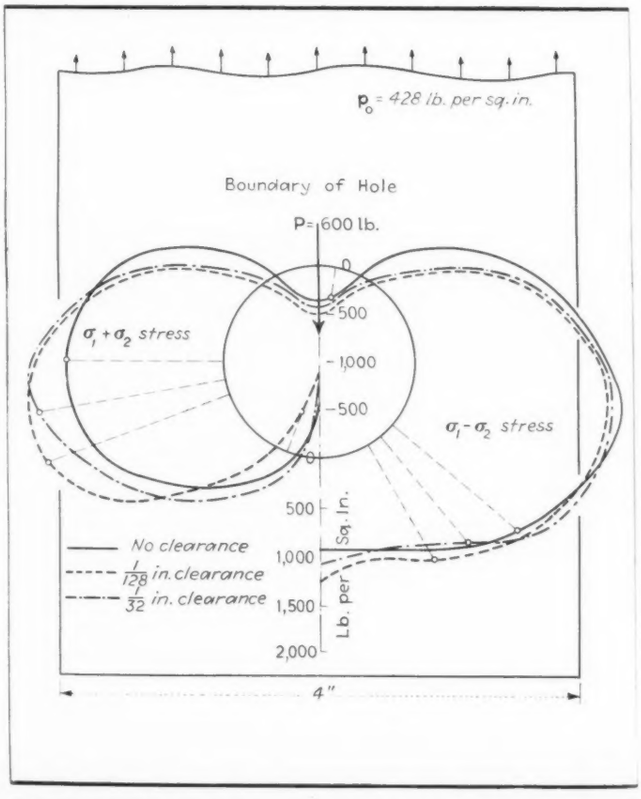



*Fig. 7—Distribution of $(\sigma_1 - \sigma_2)$ and $(\sigma_1 + \sigma_2)$ stresses at boundary of hole in plate with different pin clearances*

the boundary of the hole at distances gradually increasing from the applied load for the clearances of 1/32, 1/124 and 0 in. respectively.

The effect of clearance is found to be very little on the stress distribution for the horizontal section. On the other hand, the stresses on the vertical section are considerably increased with increasing clearances. For this section, the increase of the maximum $\sigma_2$ stress (radial) is found from Fig. 9 to be about 14 per cent for a clearance of 1/124 in. and about 30 per cent for a clearance of 1/32 in. While the increase of maximum $\sigma_1$ stress on the horizontal section is about 7.5 per cent with a corresponding decrease of the minimum $\sigma_1$ stress at the outer edge of the plate.

It will be of interest to observe that the maximum stress in this connection for the dimensions as adopted in the model, happens to be on the boundary of the hole, on a diametrical section at right angles with the applied force, instead of directly under the applied force, as might be suspected. The same thing of course may not be true if a larger width of plate were adopted. As a matter of fact all the above discussions apply only to the special size of model adopted. For general conclusions, it will be necessary to investigate experimentally a great number of pin and plate connections with size of hole and lengths of horizontal and vertical sections as variable, in order to be able to design the actual structures for safety within elastic stresses, from the results of model analysis by photoelastic methods.

This photoelastic investigation of the pin and plate problem is presented for the purpose of filling the gap which now exists between various analytical solutions which have been offered and the great number of mechanical tests which have been conducted. The analytical solutions, of which the classical formula by Herz is the most commonly used, give accurate results for concentrated loads applied on flat surfaces of which the radius of curvature is infinitely large. However, when this radius becomes smaller approaching that of the pin through which the force is transmitted to the bearing plate, theoretical formulas are no longer dependable. On the other hand, mechanical tests have been more or less used to determine the ultimate failure of pin connected plates in bridge construction, without presenting a complete solution for the distribution of the principal stresses over the various sections of the bearing plate.

There are a great many mechanical and structural engineering designs which are fundamentally pin and plate connections. Of these the most important are: cylindrical rollers resting over curved surfaces, axle and wheel combinations, and pin and riveted connections of multiplate members.

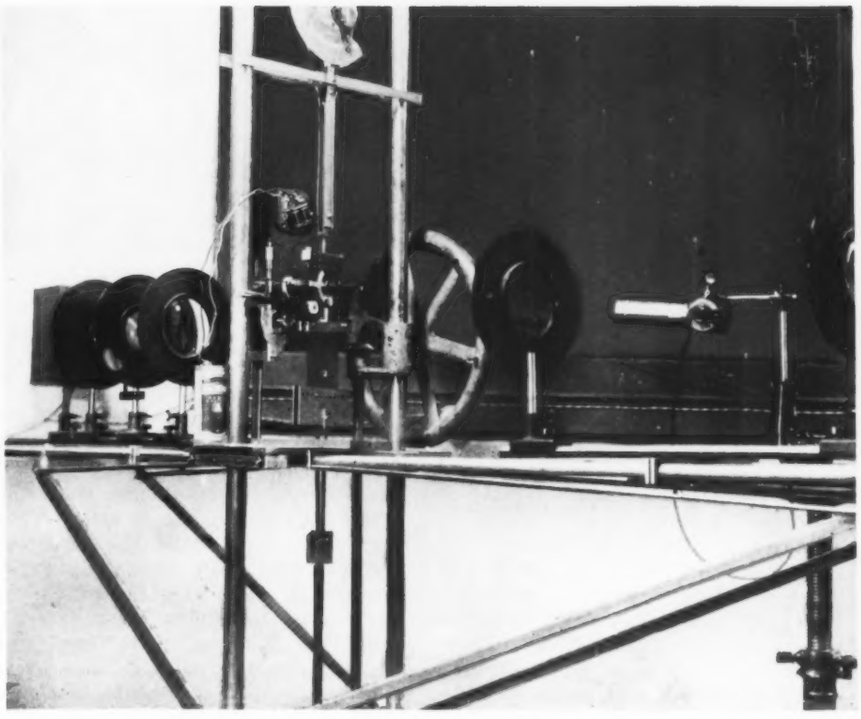


*Fig. 8—Arrangement for measuring $\Delta t$ by means of Coker's lateral extensometer*

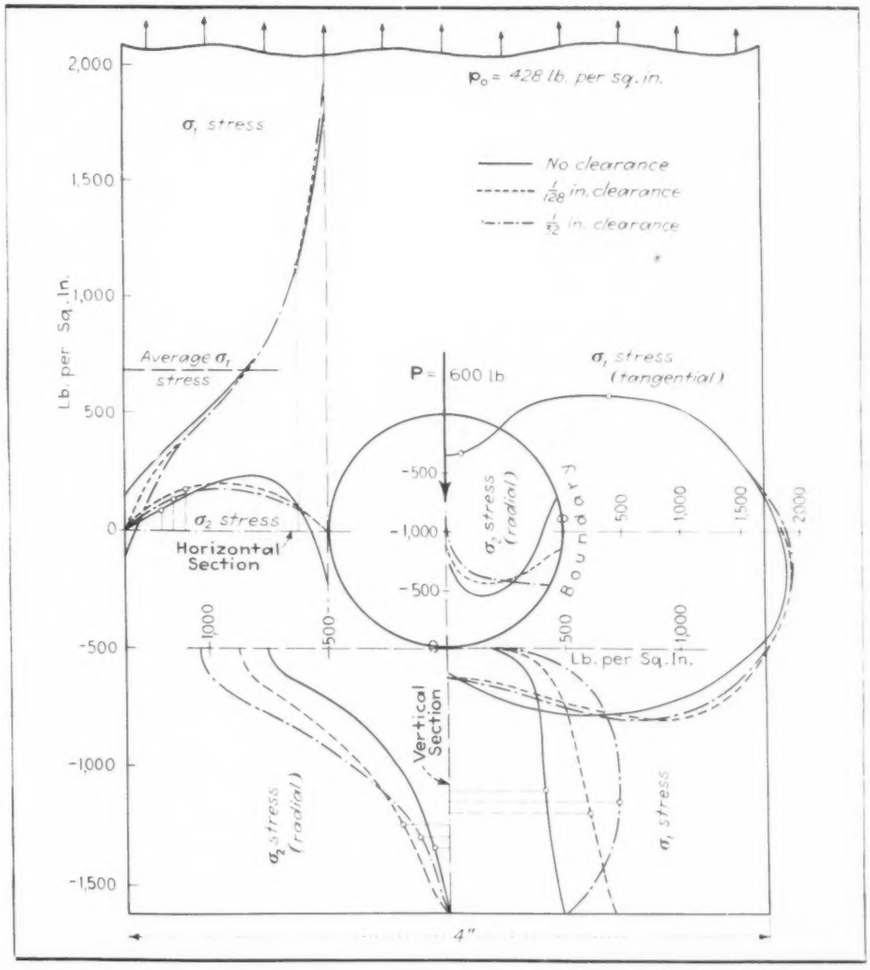



*Fig. 9—Distribution of principal stresses $\sigma_1$ and $\sigma_2$ in plate and at boundary of hole, with three different conditions of clearances in plate*

# Question and Comment

## Corrosion Prevention in Liquid-Tight Joints

ED WEST

The article "Liquid-Tight Riveted Joints," by Fred M. Morris, on page 348 of the August number recalled to mind a talk given by Com. R. S. Barnaby at the annual meeting of the Institute of Aeronautical Sciences last January.

Com. Barnaby pointed out that experiences with aluminum alloy structures such as seaplanes and flying boats in the Canal Zone and similar tropical climates where corrosion is accelerated indicated certain problems with riveted joints which must be overcome by careful design. I quote from his paper for the benefit of those who did not hear his talk or are not directly concerned with the aviation industry.

"The rules for corrosion prevention can be summed up in one statement, that is, keep the moisture away. The carrying out of such a program in practice, however, is sometimes difficult, and requires diligent study and care.

"First, all crevices must be filled. This means that the sealing of all joints is imperative whether they are structurally designed as water-tight joints or not. In general, setting in wet primer is not sufficient, for materials being worked with are not flat enough—they distort between fastenings leaving crevices greater than the paint can fill. Probably the nearest approach to a perfect seam would be one made up as follows: (a) the parts, having been properly prepared, drilled, anodized, and primed, a generous amount of suitable plastic seaming compound laid along the joint; (b) the parts are drawn together with the fastening rivets, bolts or screws which have been dipped in primer just before driving; (c) the excess compound is cleaned away, leaving generous fillets along the free edges.

"Insulation by placing a thin gasket of fabric, aluminum foil, or phenol fiber between the two parts is not sufficient. Water can bridge the insulation resulting in corrosion. In the past, attempts have been made to prevent this by the use of a larger gasket, but since the gasket was usually thin and flexible the free edges did not lie flat on the metal and so formed a crevice to hold water and promote corrosion. In many cases where a fabric gasket has been used it has not been thoroughly impregnated and so has served as a wick to draw moisture into the joint.

"The insulator must be impervious to moisture. It must be large enough to prevent water-bridging. It must be stiff enough to prevent lifting. The whole joint must be sealed with some compound to prevent the entrance of moisture.

"Similar precautions must be taken with steel bolts and rivets which pass through aluminum alloy. In such cases, particularly along the shanks, insulation as discussed above is not practicable. This makes it doubly necessary to keep water away by using compound in the joints, dipping the fastening in primer before inserting and, where possible, using insulating washers under heads and nuts, and finally, filleting all joints and around heads and nuts, with compound before the final paint coats.

"A method which has been used fairly successfully in the case of large and important structural fittings has been, after the steel fitting was riveted in place, to sand-blast it and the adjacent metal lightly and then metal-spray the whole area with aluminum, building up generous fillets along all seams around fastenings. The hole was then finished with the improved fibre and paint coating. This method has been used successfully to prevent corrosion around and under wing-hinge fittings.

"Moisture absorbing material, such as unimpregnated fabrics, felts, wood, leather and the like should not be used in contact with the structure."

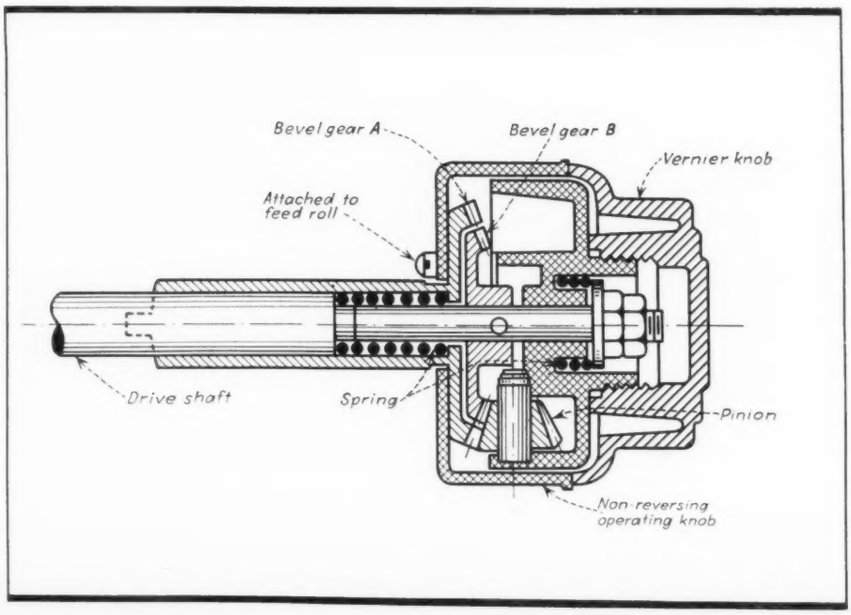
## Vernier Mechanism

*To the Editor:*

One of the most interesting mechanisms I have recently run across is this feed roll vernier used by International Business Machines Corporation in one of their latest designs. The purpose of the assembly is to provide a manual or mechanical $\frac{1}{3}$-in. advance of the roll counterclockwise as viewed from the end of the vernier knob; and to manually position the roll in small increments of the normal line spacing. Its operation is as follows:

Mechanical drive is through the shaft to which the bevel gear *B* is pinned. Bevel gear *A* is permanently fastened by a tongue and groove to the feed roll. The pinion, one of three similar pinions, remains stationary, and entire assembly and feed roll rotate with shaft. Any reverse motion of the assembly is prevented by a dog stop in the drive mechanism not shown here.

Vernier operation is effected by turn-



ing the vernier knob. Rotation of this knob in either direction rotates pinion which is pivoted in a carrier attached to the knob. Gears *B* and *A* have a different number of teeth, creating a differential motion when the knob is turned. Since gear *B* is in a fixed position during this operation, the roll rotates the desired fraction of a line space.

To avoid lost motion in line spacing caused by play between gears *A* and *B*, the three pinions are held in snug mesh with *B* by a spring. Pressing against floating gear *A* is another spring which prevents play between *A* and the pinions. —HERBERT CHASE
*Forest Hills, N. Y.*

## Photographic Tracings In Drafting Room Practice

*To the Editor:*

Just recently I ran across an interesting article in the April, 1938, *Product Engineering*, by Mr. H. J. Delchamps. It is the first time that I have seen shortcuts in drafting recommended, although I have been trying to put this system into effect for a number of years.

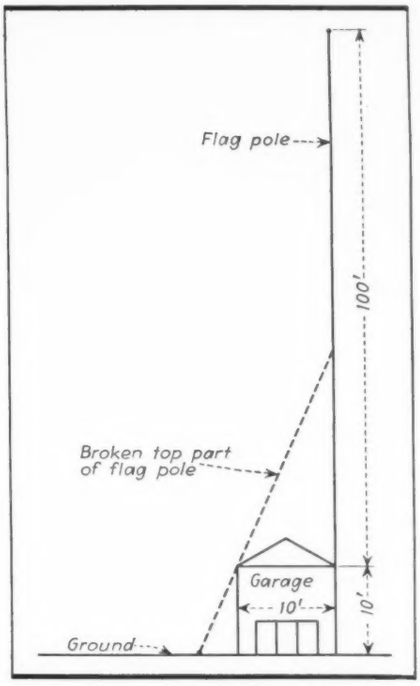
I am especially interested in the photographic tracings and would greatly appreciate information on the size of the drawing which can be reproduced, and also information on the type of photographic equipment necessary for this work. —B. W. SHEAHAN
*Consolidated Aircraft Corp.*

*To the Editor:*

The reproduction process from paper drawings, referred to in my article in the March and April, 1938, numbers of *Product Engineering*, involves first making a haloid negative by a camera process. This negative is then printed by contact methods in a blueprint machine or vacuum frame on sensitized tracing cloth which is commercially available. In connection with ink tracings made on cloth, the only difference in the process is that a vandyke negative may be used in place of the haloid negative.

We do not do the reproduction work ourselves because of the fact that we are located where we can have it done at a reasonable cost by such companies as Charles Bruning Company, Inc. and Keuffel and Esser Company. Mr. Sheahan may find that these companies or others in the business are prepared to furnish such service in San Diego or at least as close as Los Angeles.

So far as Mr. Sheahan's question regarding size is concerned, this feature is limited only by the size of the materials and equipment with which the work is done. We quite generally reproduce tracings measuring 39 in. x 42 in. On at least one occasion we reproduced a tracing 112 in. long. —H. J. DELCHAMPS
*Bell Telephone Laboratories*




## Stumped by a Problem

*To the Editor:*

I am submitting a problem which was given to me and which has me stumped. This is probably a rather easy problem but I would appreciate seeing it worked out.

Mounted on top of a garage which is 10 ft. square is a flag pole 100 ft. high. In a wind this pole breaks and in breaking the top part of the pole just touches the ground and the top edge of the garage as shown in the diagram. How high from the ground must it break for this to happen.—KENNETH W. WINKLE
*St. Joseph, Mich.*

## Corrections for Helical Spring Tables

*To the Editor:*

Now that the last installment of the article "Helical Spring Tables" is published, I feel it necessary to call attention to a few errors which have crept into preceding installments, with the suggestion that users of the tables mark the corrections in their Reference Book Sheets now, before they forget.

On page 363 of the August number, in the sixteenth line of the first column, $P$ should be $P_1$; and in the twentieth and twenty-second lines of the third column, "load" should read "lead."

In September, page 408, Table C, the heading should, of course, read "Deflection" instead of "Reflection." Also in Table C, the table value for working stroke of $1\frac{1}{8}$ in., load increase factor of 1.8, should be 2.531 instead of 2.053.

On page 409, Table B, $\frac{5}{16}$-in. O.D., 0.072-in. wire diameter, low stress group, the spring ratio $R$ should be 2.78 instead of 2.73. For O.D. of $\frac{5}{16}$ in., 0.0915-in. wire, low stress group, the spring ratio $R$ should be 4.68 instead of 4.66.

Page 410, $1\frac{1}{4}$-in. O.D., 0.080-in. wire, medium stress group, the safe load $P$ should read 11.8 lb. instead of 11.5 lb.
—PAUL KLAMP
*East Canton, Ohio*

# *Can You Work This One?*

H. E. SMITH

*This Month's Problem—*

### *Alphabet Division*

The letters in this problem represent the digits 1, 2, 3, 4, 5, 6, 7, 8, 9, and 0. From several clues given in the division, the numerical value of each letter can quite easily be determined.

```
L E R)R B T T N(L P L
      E T L
      -----
      B L I T
      B L U S
      -------
          E T N
          E T L
          -----
              R
```

When the letters are arranged in the order of their numerical value, they name the indispensable link between design engineers and production men.

*Solution to November Problem—*

### *A Monkey and His Uncle*

A monkey and the monkey's uncle are suspended at equal distances from the floor at opposite ends of a rope which passes through a pulley. Therefore, the weight in lb. of the monkey equals the weight of the uncle, and from the problem, also equals the age of the monkey's uncle in years. Since the sum of the two ages is 4 years, the ages must be $1\frac{1}{2}$ years for the monkey and $2\frac{1}{2}$ years for the uncle in order to fill the requirements of the problem. Therefore, their weight must be $2\frac{1}{2}$ lb. each. The last condition stated then reduces to: the total weight of the rope (at 4 oz. per ft.) is one-half the weight of the monkey, or $1\frac{1}{4}$ lb., giving 5 ft. for the length of the rope. Simple, wasn't it?

# News

## *Production of Powdered Iron Lags Behind Demands of Increased Uses*

**Process which can produce material at reasonable cost is sought as large volume applications are developed**

DEVELOPMENTS in the uses and in methods for forming parts of powdered iron are ahead of the art of manufacturing the material itself, recent reports reveal. Because of its purity and physical characteristics, there is a ready market for powdered iron from which to make articles that are expensive to machine or cast but which are easy to make by compressing powdered metal into a die. As industry learns the economic value of the powdered metal processes the increase in rate of market demand will depend upon the development of less costly dies and upon improved technique in preparing materials.

At present less than two tons of iron powder are consumed per day. Bearings made of compressed iron powder, which require no oil grooves because their porous structure has capillary properties, are now widely used. Gears, pump rotors, and similar parts are now ready for production. Large automobile companies report that the peculiar frictional properties of the soft, porous iron make it suitable for use in brake drums. Powdered iron is considered as a base for wrought iron and high-grade alloys.

Here is indicated a large potential market for the powdered metal, but present sources are somewhat limited. Swedish sponge iron has, up to the present, filled most of this country's demands. American-made iron is either of the electrolytic type, produced in small quantities at high cost, or is still in the pilot-plant stage.

Metallurgists are now concentrating their attention on the possibilities of the as yet commercially unsuccessful production of powdered iron by low temperature reduction processes. The method consists of conversion of oxide ore into metallic iron by the action of carbon monoxide or some other reducing gas. The temperature of the process can be kept low enough to avoid sintering or melting the charge, so that powdered ore will yield powdered iron, and crushed ore will yield sponge iron. The process, when carefully controlled, permits selective reduction of the iron alone.

The problem is to obtain on the one hand a powder cheap enough to compare favorably with the price for iron or steel and at the same time pure enough to give comparatively high physical characteristics. It is believed that the problem will be solved in this country, as soon as the demand becomes great enough, by an American mass-production process using American raw material.

## *Carbon Dioxide Systems Installed in Airplanes*

AUTOMATIC carbon dioxide fire-fighting equipment is now a regular safety feature in airplane design. Many combat planes built in this country for foreign governments have tiny flame detectors placed in the engine compartment which discharge a cloud of the flame-starving gas into the compartment at the first sign of fire. Manually-controlled systems are standard equipment on American transport planes.

The gas, released through perforated tubing, penetrates to every part of the engine and carburetor despite the force of the slipstream, snuffing out the fire in a few seconds. Light steel alloy cylinders have reduced the weight to about 14 lb. for a complete unit.

Another military use for carbon dioxide is in the flotation gear of naval planes. When a plane is forced down at sea, automatic detectors operate to inflate rubberized bags located in the wings or fuselage with gas from pressure cylinders. Similarly, the rubberized vest worn by naval fliers can be instantly inflated by pulling a cord which punctures a tiny cylinder of carbon dioxide.

**Heat treatment** of an automobile hub takes only a few seconds as the head of this machine, developed by the E. G. Budd Company, is lowered into the hub, heating the surface of the bore to a high temperature by electrical induction.

## *Standards Bureau Makes Precision Circles*

PRECISION CIRCLES for use in accurately measuring horizontal angles are being constructed, graduated and calibrated by the National Bureau of Standards in a new program recently undertaken. Accurately graduated theodolite circles are required by the United States Coast and Geodetic Survey in its base line and triangulation work.

About six years ago the work of providing circles of the desired accuracy was first undertaken, and 57 circles were completed in a period of about two years. The circles are divided into two classes: the first order, 9 in. in diameter, graduated to 5-min. intervals; and the second order, 6½ in. in diameter, graduated to 10-min. intervals. They are both accurate to 1 part in 108,000, or 2 sec. of the arc.

Before the work of graduating the circles was undertaken by the Bureau, it had been done in Germany where the price for such work ranged upwards of $100 per circle. However, these graduations did not prove sufficiently accurate for base line work of the Coast and Geodetic Survey.

## *British Engineers Test Gasoline Substitutes*

BRITAIN is testing three types of automotive power sources, according to a U. S. Vice Consul's report. They are: gas produced from solids burned in a generator on the vehicle; compressed illuminating gas carried in special cylinders at 3,000 lb. per sq. in.; and electric power from batteries. Illuminating gas, which gives a motor efficiency loss of from 10 to 30 per cent as compared with gasoline, shows the most promise

Storage of the tanks on the vehicle is difficult. Six cylinders are carried on a trailer in the case of automobiles. On trucks and buses the space problem is easier. Development of light weight tanks to withstand the high pressure was the hardest technical problem.

## *150th Year of Patents To Be Commemorated*

OUTSTANDING INVENTORS and research workers will be honored early in 1940 by the National Association of Manufacturers in connection with the observance of the 150th anniversary of the American Patent System and the inauguration of this great stimulus to invention, research and industrial progress. From five to fifteen men will be presented with "Modern Pioneer" awards for pioneering achievements on the frontiers of American industry, at a national dinner to be given on February 27 in New York.

Manufacturers, members of trade associations and professional engineering and scientific societies have been invited to nominate inventors and research workers to receive the Modern Pioneer awards. A committee of eminent scientists, headed by Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, will judge the nominees on the basis of the contributions of their inventions and discoveries to the creation of new jobs, new industries and new goods and services which have raised the American standard of living. Previous to the national program, which will be broadcast over the radio, industrial communities throughout the country will honor their outstanding research men at local or regional dinners.

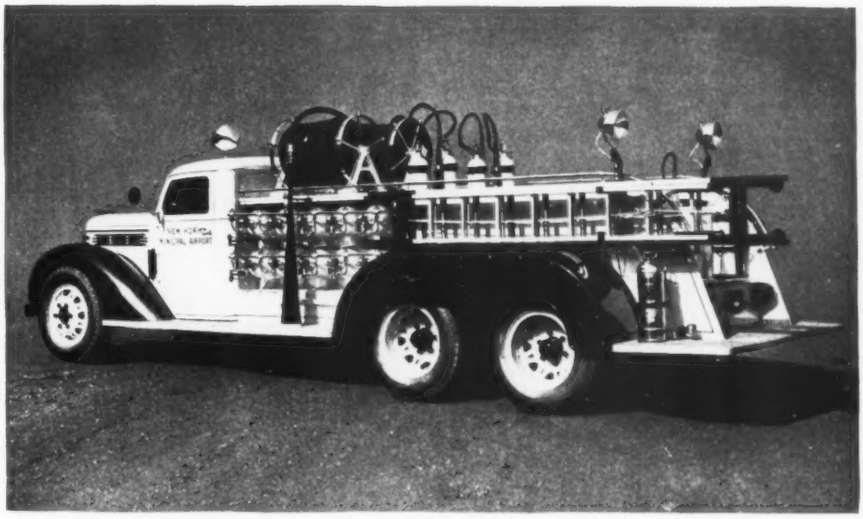
## *Meetings*

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—60th Annual Meeting, Bellevue-Stratford Hotel, Philadelphia, Pa., December 4–8. C. E. Davies, secretary, 29 West 39th St., New York, N. Y.

SEVENTEENTH EXPOSITION OF CHEMICAL INDUSTRIES—Grand Central Palace, New York, N. Y., Dec. 4–9. Charles F. Roth, Grand Central Palace, New York.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE—Winter Meeting, Columbus, Ohio, December 27–January 2. Dr. F. R. Moulton, secretary, Smithsonian Institute, Washington, D. C.

SOCIETY OF AUTOMOTIVE ENGINEERS—Annual Meeting and Engineering Display, Book-Cadillac Hotel, Detroit, Mich., January 15–19, 1940. John A. C. Warner, secretary, 29 West 39th St., New York.



**Crash truck,** designed by Walter Kidde, speeds fire-fighting equipment around New York's new Long Beach Airport. Two rows of five 100-lb. Lux cylinders each are connected through flexible metal tubing and manifold to two trunion-fed reels, each reel having 200 ft. of 1-in. high pressure hose feeding to plastic discharge horn. Banks are independently thrown into operation by lever which opens two master cylinders. Pressure in manifold then causes piston valves to open remaining cylinders. Other equipment includes portable extinguishers, Gar Wood hoist, and cables for grappling and towing burning planes.

## *Research To Clarify Properties of Forgings*

COMPARATIVE physical properties and merits of forgings and castings will be established by metallurgical research now being undertaken by the Technical Committee of the Drop Forging Association. The purpose of the work is to clarify, for the benefit of the metal working industry, the various claims that are made for these fabricating processes.

The values to be determined are: tensile strength; yield point or elastic limit; reduction of area; elongation; hardness; Charpy and Izod impact tests; relative tool cost; and relative machining cost. Microphotographs and illustrations will be obtained to substantiate the results of the analyses and tests. All tests are to be conducted on regular production pieces.

Initiating its activities along these lines, the committee will eventually broaden its program to include the collection and preparation of scientific data already existing, and the origination of research projects for the purpose of bettering forging processes.

## *Graduate Course Given In Industrial Design*

INDICATIVE of the recognition of industrial design as a profession, the California Graduate School of Design, which awards a Master's degree for the satisfactory completion of a two-year curriculum, is now entering its third year. The school, closely allied with the California Institute of Technology, is the first of its type in this country.

Students with a thorough training in art are given a broad professional knowledge of all of the phases that enter into the conception, the making, the selling and the buying of a product. The curriculum is based on a practical case system wherein the student receives his problems directly from industry and solves them according to industry's requirements and under its supervision.

## *Do You Know That—*

FLUID HOT CAUSTIC, shipped at 165 deg F. in insulated tank cars, remains perfectly fluid during ten days of transit. Tank is thus insulated by 10 in. of rock wool stitched between wire mesh. (31)

METAL MOVIE FILM which is thinner, lighter, and more resistant to wear and exposure than its celluloid counterpart has been successfully used in Germany. Pictures are reflected from highly polished, photographically-treated, aluminum surface. (32)

INDIUM, one of the newer metals for the consideration of the electro-plater, imparts tarnish-resisting qualities to silver. Resembling platinum in luster, it melts at 155 deg. C. (33)

FUSED QUARTZ is being used for springs in research laboratories to indicate minute differences in weight. (34)

# *Helical Spring Tables—IV*

PAUL KLAMP

## Table B—Selection of Springs

*Continued from p. 510, November Number***

| Spring O. D. In. | Wire Dia. In. | Spring I. D. In. | Low Stress Group | | | | Medium Stress Group | | | | High Stress Group | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Coils Per In. | Safe Load *P* Lb. | Spring Ratio *R* | Defl. Per Coil *f* In. | Coils Per In. | Safe Load *P* Lb. | Spring Ratio *R* | Defl. Per Coil *f* In. | Coils Per In. | Safe Load *P* Lb. | Spring Ratio *R* | Defl. Per Coil *f* In. |
| | .1205 | 1.631 | 2 | 19.6 | 1.43 | .350 | 1½ | 21.1 | 1.55 | .429 | 1⅜ | 28.9 | 1.41 | .515 |
| | ⅛ | 1.625 | 2 | 21.9 | 1.50 | .331 | 1¾ | 26.9 | 1.39 | .410 | 1½ | 32.2 | 1.35 | .492 |
| | .135 | 1.605 | 2 | 27.5 | 1.65 | .303 | 1¾ | 33.7 | 1.53 | .372 | 1½ | 40.5 | 1.49 | .417 |
| | .1483 | 1.578 | 2¼ | 36.3 | 1.65 | .269 | 1¾ | 44.6 | 1.73 | .330 | 1½ | 53.5 | 1.68 | .396 |
| | 5/32 | 1.563 | 2¼ | 42.4 | 1.77 | .251 | 2 | 52.0 | 1.62 | .308 | 1¾ | 62.4 | 1.54 | .370 |
| | .162 | 1.551 | 2¼ | 47.2 | 1.86 | .239 | 2 | 57.9 | 1.70 | .294 | 1¾ | 69.5 | 1.62 | .353 |
| | .177 | 1.521 | 2¼ | 61.3 | 2.09 | .213 | 2 | 75.2 | 1.92 | .261 | 1¾ | 90.2 | 1.83 | .313 |
| | 3/16 | 1.500 | 2½ | 72.6 | 2.04 | .196 | 2 | 89.1 | 2.07 | .241 | 2 | 107 | 1.73 | .289 |
| | .192 | 1.491 | 2½ | 77.8 | 2.11 | .190 | 2¼ | 95.5 | 1.91 | .233 | 2 | 115 | 1.79 | .280 |
| 1⅞″ | .207 | 1.461 | 2½ | 97.1 | 2.34 | .171 | 2¼ | 119 | 2.12 | .210 | 2 | 143 | 1.99 | .251 |
| | .2253 | 1.424 | 2½ | 125 | 2.65 | .151 | 2¼ | 153 | 2.40 | .185 | 2 | 183 | 2.25 | .222 |
| | .2437 | 1.388 | 2½ | 143 | 3.28 | .122 | 2¼ | 171 | 3.04 | .146 | 2¼ | 205 | 2.53 | .176 |
| | ¼ | 1.375 | 2½ | 153 | 3.41 | .117 | 2¼ | 184 | 3.16 | .141 | 2¼ | 221 | 2.63 | .169 |
| | .2625 | 1.350 | *0.395 | 177 | 3.64 | .109 | *0.420 | 212 | 3.22 | .130 | *0.445 | 255 | 2.85 | .156 |
| | .283 | 1.309 | *0.405 | 220 | 4.21 | .0962 | *0.425 | 264 | 3.68 | .115 | *0.450 | 317 | 3.25 | .139 |
| | .3065 | 1.262 | *0.420 | 277 | 4.99 | .0842 | *0.440 | 332 | 4.36 | .101 | *0.460 | 399 | 3.79 | .121 |
| | 5/16 | 1.250 | *0.425 | 293 | 5.22 | .0814 | *0.440 | 351 | 4.50 | .0977 | *0.460 | 421 | 3.92 | .117 |
| | .331 | 1.213 | *0.435 | 345 | 5.91 | .0736 | *0.450 | 414 | 5.09 | .0883 | *0.470 | 497 | 4.43 | .106 |
| | .3625 | 1.150 | *0.460 | 417 | 7.38 | .0623 | *0.475 | 536 | 6.35 | .0748 | *0.490 | 644 | 5.46 | .0897 |
| | ⅜ | 1.125 | *0.470 | 492 | 8.05 | .0584 | *0.480 | 590 | 6.85 | .0701 | *0.495 | 708 | 5.89 | .0841 |
| | ⅛ | 1.750 | 1¾ | 20.6 | 1.48 | .386 | 1½ | 25.2 | 1.41 | .474 | 1¼ | 30.3 | 1.41 | .568 |
| | .135 | 1.730 | 1¾ | 25.8 | 1.63 | .351 | 1½ | 31.7 | 1.55 | .430 | 1⅜ | 38.0 | 1.41 | .516 |
| | .1483 | 1.703 | 2 | 34.2 | 1.60 | .312 | 1¾ | 41.9 | 1.49 | .383 | 1½ | 50.3 | 1.15 | .459 |
| | 5/32 | 1.688 | 2 | 39.9 | 1.72 | .292 | 1¾ | 48.9 | 1.60 | .358 | 1½ | 58.7 | 1.55 | .430 |
| | .162 | 1.676 | 2 | 44.3 | 1.80 | .278 | 1¾ | 54.4 | 1.68 | .341 | 1½ | 65.3 | 1.63 | .409 |
| | .177 | 1.646 | 2¼ | 57.6 | 1.80 | .247 | 1¾ | 70.7 | 1.88 | .303 | 1¾ | 81.8 | 1.57 | .364 |
| | 3/16 | 1.625 | 2¼ | 68.3 | 1.94 | .229 | 2 | 83.8 | 1.78 | .281 | 1¾ | 101 | 1.70 | .337 |
| | .192 | 1.616 | 2¼ | 73.3 | 2.01 | .222 | 2 | 89.9 | 1.84 | .272 | 1¾ | 108 | 1.75 | .327 |
| 2″ | .207 | 1.586 | 2¼ | 91.4 | 2.23 | .200 | 2 | 112 | 2.04 | .245 | 1¾ | 135 | 1.91 | .294 |
| | .2253 | 1.549 | 2¼ | 117 | 2.51 | .177 | 2 | 144 | 2.30 | .217 | 1¾ | 173 | 2.19 | .261 |
| | .2437 | 1.513 | 2¼ | 134 | 3.10 | .143 | 2¼ | 161 | 2.58 | .172 | 2 | 193 | 2.42 | .207 |
| | ¼ | 1.500 | 2¼ | 145 | 3.22 | .138 | 2¼ | 173 | 2.68 | .166 | 2 | 208 | 2.52 | .199 |
| | .2625 | 1.475 | *0.415 | 167 | 3.24 | .128 | *0.415 | 200 | 2.89 | .151 | *0.475 | 240 | 2.57 | .185 |
| | .283 | 1.434 | *0.425 | 208 | 3.73 | .111 | *0.450 | 249 | 3.29 | .137 | *0.475 | 299 | 2.90 | .164 |
| | .3065 | 1.387 | *0.435 | 261 | 4.35 | .100 | *0.455 | 314 | 3.79 | .120 | *0.480 | 376 | 3.33 | .114 |
| | 5/16 | 1.375 | *0.440 | 277 | 4.54 | .0969 | *0.460 | 332 | 3.95 | .116 | *0.485 | 398 | 3.47 | .110 |
| | .331 | 1.338 | *0.450 | 326 | 5.12 | .0879 | *0.470 | 391 | 4.46 | .106 | *0.490 | 470 | 3.87 | .127 |
| | .3625 | 1.275 | *0.475 | 423 | 6.34 | .0749 | *0.490 | 508 | 5.45 | .0899 | *0.505 | 610 | 4.68 | .108 |
| | ⅜ | 1.250 | *0.480 | 466 | 6.82 | .0704 | *0.495 | 559 | 5.86 | .0844 | *0.510 | 671 | 5.03 | .101 |
| | .3938 | 1.212 | *0.495 | 535 | 7.72 | .0641 | *0.510 | 642 | 6.63 | .0770 | *0.525 | 771 | 5.68 | .0924 |
| | .1483 | 1.953 | 1½ | 30.5 | 1.64 | .407 | 1⅜ | 37.4 | 1.46 | .499 | 1¼ | 41.9 | 1.34 | .599 |
| | 5/32 | 1.938 | 1¾ | 35.6 | 1.50 | .381 | 1½ | 43.7 | 1.43 | .468 | 1¼ | 52.4 | 1.43 | .561 |
| | .162 | 1.926 | 1¾ | 39.6 | 1.57 | .364 | 1½ | 48.6 | 1.49 | .447 | 1¼ | 58.3 | 1.49 | .536 |
| | .177 | 1.896 | 1¾ | 51.5 | 1.76 | .325 | 1½ | 63.2 | 1.67 | .400 | 1⅜ | 75.8 | 1.52 | .479 |
| | 3/16 | 1.875 | 1¾ | 61.0 | 1.90 | .302 | 1½ | 75.0 | 1.80 | .370 | 1½ | 89.9 | 1.50 | .444 |
| | .192 | 1.866 | 1¾ | 65.5 | 1.96 | .292 | 1½ | 80.3 | 1.86 | .359 | 1½ | 96.4 | 1.55 | .430 |
| | .207 | 1.836 | 2 | 81.8 | 1.89 | .264 | 1¾ | 100 | 1.76 | .324 | 1½ | 120 | 1.71 | .389 |
| | .2253 | 1.799 | 2 | 105 | 2.13 | .235 | 1¾ | 129 | 1.98 | .289 | 1½ | 155 | 1.93 | .316 |
| 2¼″ | .2437 | 1.763 | 2 | 120 | 2.61 | .192 | 2 | 144 | 2.18 | .230 | 1¾ | 173 | 2.07 | .276 |
| | ¼ | 1.750 | 2 | 130 | 2.71 | .185 | 2 | 155 | 2.26 | .222 | 1¾ | 187 | 2.15 | .266 |
| | .2625 | 1.725 | *0.460 | 149 | 2.68 | .172 | *0.495 | 179 | 2.40 | .206 | *0.535 | 215 | 2.16 | .248 |
| | .283 | 1.684 | *0.465 | 186 | 3.02 | .154 | *0.495 | 224 | 2.68 | .185 | *0.535 | 268 | 2.42 | .221 |
| | .3065 | 1.637 | *0.475 | 235 | 3.49 | .136 | *0.500 | 282 | 3.06 | .163 | *0.535 | 339 | 2.73 | .196 |
| | 5/16 | 1.625 | *0.475 | 249 | 3.60 | .132 | *0.500 | 298 | 3.16 | .158 | *0.535 | 358 | 2.82 | .190 |
| | .331 | 1.588 | *0.485 | 294 | 4.03 | .120 | *0.510 | 353 | 3.53 | .115 | *0.535 | 423 | 3.09 | .173 |
| | .3625 | 1.525 | *0.500 | 382 | 4.83 | .104 | *0.525 | 459 | 4.23 | .124 | *0.550 | 550 | 3.69 | .119 |
| | ⅜ | 1.500 | *0.510 | 421 | 5.22 | .0977 | *0.530 | 506 | 4.52 | .117 | *0.555 | 607 | 3.94 | .111 |
| | .3938 | 1.462 | *0.520 | 485 | 5.80 | .0897 | *0.540 | 582 | 5.02 | .108 | *0.560 | 698 | 4.34 | .129 |
| | 7/16 | 1.375 | *0.555 | 654 | 7.51 | .0739 | *0.570 | 785 | 6.42 | .0887 | *0.585 | 942 | 5.50 | .107 |

* Values given in terms of lead, *L*.

** Concluding presentation of quick method of spring selection.

## Table B—Selection of Springs

| Spring O. D. In. | Wire Dia. In. | Spring I. D. In. | Low Stress Group | | | | Medium Stress Group | | | | High Stress Group | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Coils Per In. | Safe Load $P$ Lb. | Spring Ratio $R$ | Defl. Per Coil $f$ In. | Coils Per In. | Safe Load $P$ Lb. | Spring Ratio $R$ | Defl. Per Coil $f$ In. | Coils Per In. | Safe Load $P$ Lb. | Spring Ratio $R$ | Defl. Per Coil $f$ In. |
| | 5/32 | 2.188 | 1 3/8 | 32.1 | 1.51 | .482 | 1 1/4 | 39.4 | 1.35 | .592 | 1 | 47.3 | 1.41 | .710 |
| | .162 | 2.176 | 1 1/2 | 35.8 | 1.45 | .462 | 1 1/4 | 43.9 | 1.41 | .566 | 1 | 52.7 | 1.47 | .680 |
| | .177 | 2.146 | 1 1/2 | 46.5 | 1.61 | .413 | 1 3/8 | 57.1 | 1.43 | .507 | 1 1/8 | 68.5 | 1.46 | .608 |
| | 3/16 | 2.125 | 1 1/2 | 55.2 | 1.74 | .384 | 1 3/8 | 67.7 | 1.54 | .471 | 1 1/4 | 81.3 | 1.42 | .566 |
| | .192 | 2.116 | 1 1/2 | 59.2 | 1.79 | .373 | 1 3/8 | 72.6 | 1.59 | .457 | 1 1/4 | 87.2 | 1.46 | .549 |
| | .207 | 2.086 | 1 3/4 | 73.4 | 1.69 | .338 | 1 1/2 | 90.7 | 1.61 | .415 | 1 1/4 | 109 | 1.61 | .497 |
| | .2253 | 2.049 | 1 3/4 | 94.9 | 1.89 | .302 | 1 1/2 | 117 | 1.80 | .370 | 1 3/8 | 140 | 1.64 | .444 |
| | .2437 | 2.013 | 1 3/4 | 112 | 2.25 | .254 | 1 3/4 | 134 | 1.88 | .304 | 1 1/2 | 161 | 1.83 | .365 |
| 2 1/2″ | 1/4 | 2.000 | 1 3/4 | 117 | 2.40 | .238 | 1 3/4 | 141 | 2.00 | 2.86 | 1 1/2 | 169 | 1.95 | .343 |
| | .2625 | 1.975 | *0.510 | 136 | 2.28 | .223 | *0.555 | 163 | 2.07 | .268 | *0.615 | 196 | 1.91 | .322 |
| | .283 | 1.934 | *0.510 | 169 | 2.56 | .200 | *0.550 | 203 | 2.30 | .239 | *0.600 | 243 | 2.09 | .287 |
| | .3065 | 1.887 | *0.515 | 213 | 2.90 | .178 | *0.550 | 256 | 2.58 | .213 | *0.590 | 307 | 2.31 | .256 |
| | 5/16 | 1.875 | *0.515 | 226 | 2.99 | .172 | *0.550 | 271 | 2.66 | .207 | *0.590 | 325 | 2.38 | .248 |
| | .331 | 1.838 | *0.520 | 267 | 3.29 | .158 | *0.555 | 321 | 2.93 | .190 | *0.590 | 385 | 2.59 | .228 |
| | .3625 | 1.775 | *0.535 | 348 | 3.91 | .137 | *0.565 | 418 | 3.44 | .164 | *0.595 | 501 | 3.02 | .197 |
| | 3/8 | 1.750 | *0.540 | 384 | 4.17 | .130 | *0.570 | 460 | 3.67 | .155 | *0.600 | 553 | 3.22 | .187 |
| | .3938 | 1.712 | *0.550 | 442 | 4.60 | .120 | *0.575 | 530 | 4.01 | .143 | *0.605 | 637 | 3.52 | .172 |
| | 7/16 | 1.625 | *0.580 | 598 | 5.82 | .0996 | *0.600 | 718 | 5.02 | .120 | *0.625 | 861 | 4.36 | .144 |
| | 1/2 | 1.500 | *0.630 | 874 | 8.10 | .0778 | *0.645 | 1049 | 6.91 | .0934 | *0.660 | 1259 | 5.89 | .112 |
| | .177 | 2.396 | 1 1/4 | 42.4 | 1.56 | .513 | 1 1/8 | 52.1 | 1.41 | .629 | 1 | 62.5 | 1.33 | .755 |
| | 3/16 | 2.375 | 1 3/8 | 50.3 | 1.53 | .477 | 1 1/8 | 61.8 | 1.52 | .585 | 1 | 74.1 | 1.43 | .702 |
| | .192 | 2.366 | 1 3/8 | 54.0 | 1.57 | .463 | 1 1/8 | 66.3 | 1.57 | .568 | 1 | 79.5 | 1.47 | .681 |
| | .207 | 2.336 | 1 1/2 | 67.5 | 1.59 | .421 | 1 1/4 | 82.8 | 1.55 | .516 | 1 1/8 | 99.4 | 1.44 | .619 |
| | .2253 | 2.299 | 1 1/2 | 86.7 | 1.77 | .377 | 1 3/8 | 106 | 1.57 | .463 | 1 1/8 | 128 | 1.60 | .555 |
| | .2437 | 2.263 | 1 1/2 | 99.4 | 2.16 | .309 | 1 1/2 | 119 | 1.80 | .370 | 1 3/8 | 143 | 1.64 | .444 |
| | 1/4 | 2.250 | 1 3/4 | 107 | 1.92 | .298 | 1 1/2 | 129 | 1.86 | .358 | 1 3/8 | 154 | 1.69 | .430 |
| | .2625 | 2.225 | *0.570 | 124 | 2.04 | .279 | *0.630 | 149 | 1.88 | .335 | *0.705 | 178 | 1.75 | .402 |
| 3 3/4″ | .283 | 2.184 | *0.560 | 154 | 2.23 | .252 | *0.615 | 185 | 2.04 | .302 | *0.680 | 222 | 1.88 | .362 |
| | .3065 | 2.137 | *0.560 | 195 | 2.49 | .225 | *0.605 | 234 | 2.25 | .270 | *0.660 | 281 | 2.04 | .323 |
| | 5/16 | 2.125 | *0.560 | 207 | 2.56 | .218 | *0.605 | 248 | 2.31 | .262 | *0.660 | 298 | 2.10 | .315 |
| | .331 | 2.088 | *0.565 | 245 | 2.82 | .201 | *0.605 | 294 | 2.51 | .241 | *0.655 | 352 | 2.27 | .289 |
| | .3625 | 2.025 | *0.575 | 319 | 3.29 | .175 | *0.610 | 383 | 2.90 | .210 | *0.650 | 460 | 2.58 | .252 |
| | 3/8 | 2.000 | *0.580 | 352 | 3.50 | .166 | *0.610 | 423 | 3.06 | .199 | *0.650 | 507 | 2.72 | .239 |
| | .3938 | 1.962 | *0.585 | 406 | 3.81 | .154 | *0.615 | 487 | 3.34 | .184 | *0.655 | 584 | 2.96 | .221 |
| | 7/16 | 1.875 | *0.610 | 551 | 4.72 | .129 | *0.635 | 661 | 4.09 | .155 | *0.665 | 793 | 3.57 | .186 |
| | 1/2 | 1.750 | *0.650 | 807 | 6.35 | .102 | *0.670 | 969 | 5.45 | .123 | *0.695 | 1163 | 4.72 | .147 |
| | 3/16 | 2.625 | 1 1/8 | 46.2 | 1.54 | .579 | 1 | 56.7 | 1.41 | .711 | 7/8 | 68.1 | 1.34 | .853 |
| | .192 | 2.616 | 1 1/4 | 49.6 | 1.42 | .563 | 1 | 60.9 | 1.45 | .690 | 7/8 | 73.1 | 1.38 | .828 |
| | .207 | 2.586 | 1 1/4 | 62.0 | 1.56 | .512 | 1 1/8 | 76.1 | 1.42 | .628 | 7/8 | 91.3 | 1.52 | .754 |
| | .2253 | 2.549 | 1 3/8 | 79.8 | 1.58 | .460 | 1 1/8 | 97.9 | 1.57 | .565 | 1 | 118 | 1.48 | .678 |
| | .2437 | 2.513 | 1 1/2 | 91.5 | 1.76 | .378 | 1 1/4 | 110 | 1.76 | .453 | 1 1/8 | 132 | 1.63 | .544 |
| | 1/4 | 2.500 | 1 1/2 | 98.6 | 1.83 | .365 | 1 3/8 | 118 | 1.66 | .438 | 1 1/8 | 142 | 1.69 | .526 |
| | .2625 | 2.475 | *0.610 | 114 | 1.87 | .342 | *0.715 | 137 | 1.74 | .411 | *0.805 | 164 | 1.63 | .493 |
| | .283 | 2.434 | *0.625 | 142 | 2.02 | .310 | *0.690 | 171 | 1.86 | .372 | *0.775 | 205 | 1.74 | .446 |
| 3″ | .3065 | 2.387 | *0.615 | 180 | 2.22 | .277 | *0.675 | 216 | 2.03 | .333 | *0.745 | 259 | 1.87 | .399 |
| | 5/16 | 2.375 | *0.615 | 190 | 2.28 | .270 | *0.670 | 228 | 2.07 | .324 | *0.740 | 274 | 1.91 | .388 |
| | .331 | 2.338 | *0.615 | 226 | 2.47 | .249 | *0.665 | 271 | 2.23 | .298 | *0.725 | 325 | 2.02 | .358 |
| | .3625 | 2.275 | *0.615 | 291 | 2.83 | .218 | *0.660 | 353 | 2.53 | .261 | *0.710 | 424 | 2.27 | .313 |
| | 3/8 | 2.250 | *0.620 | 325 | 3.00 | .207 | *0.660 | 390 | 2.66 | .248 | *0.710 | 468 | 2.38 | .298 |
| | .3938 | 2.212 | *0.625 | 375 | 3.26 | .192 | *0.665 | 450 | 2.89 | .230 | *0.710 | 540 | 2.57 | .277 |
| | 7/16 | 2.125 | *0.645 | 510 | 3.96 | .163 | *0.675 | 612 | 3.45 | .195 | *0.715 | 734 | 3.05 | .235 |
| | 1/2 | 2.000 | *0.680 | 749 | 5.22 | .130 | *0.705 | 899 | 4.51 | .156 | *0.735 | 1078 | 3.92 | .188 |
| | 9/16 | 1.875 | *0.725 | 1049 | 6.87 | .106 | *0.745 | 1259 | 5.88 | .127 | *0.770 | 1510 | 5.07 | .152 |
| | 207 | 2.836 | 1 1/8 | 57.4 | 1.45 | .613 | 7/8 | 70.5 | 1.52 | .752 | 13/16 | 81.6 | 1.36 | .903 |
| | .2253 | 2.799 | 1 1/8 | 73.8 | 1.61 | .552 | 1 | 90.6 | 1.48 | .677 | 7/8 | 109 | 1.41 | .812 |
| | .2437 | 2.763 | 1 1/4 | 84.7 | 1.76 | .454 | 1 1/8 | 102 | 1.63 | .545 | 1 | 122 | 1.53 | .654 |
| | 1/4 | 2.750 | 1 3/8 | 91.3 | 1.66 | .439 | 1 1/8 | 110 | 1.69 | .527 | 1 | 132 | 1.58 | .633 |
| | .2625 | 2.725 | *0.715 | 106 | 1.73 | .412 | *0.805 | 127 | 1.63 | .495 | *0.915 | 152 | 1.54 | .594 |
| | .283 | 2.684 | *0.695 | 132 | 1.86 | .373 | *0.775 | 158 | 1.73 | .448 | *0.875 | 190 | 1.63 | .538 |
| | .3065 | 2.637 | *0.675 | 167 | 2.01 | .335 | *0.750 | 200 | 1.86 | .403 | *0.840 | 240 | 1.74 | .483 |
| | 5/16 | 2.625 | *0.670 | 177 | 2.05 | .327 | *0.745 | 212 | 1.90 | .392 | *0.830 | 254 | 1.77 | .470 |
| 3 1/4″ | .331 | 2.588 | *0.665 | 209 | 2.20 | .302 | *0.730 | 251 | 2.02 | .362 | *0.810 | 301 | 1.87 | .434 |
| | .3625 | 2.525 | *0.665 | 273 | 2.51 | .265 | *0.715 | 328 | 2.25 | .318 | *0.780 | 394 | 2.04 | .382 |
| | 3/8 | 2.500 | *0.665 | 302 | 2.63 | .252 | *0.715 | 362 | 2.36 | .303 | *0.775 | 435 | 2.13 | .364 |
| | .3938 | 2.462 | *0.670 | 348 | 2.85 | .235 | *0.715 | 418 | 2.54 | .282 | *0.770 | 502 | 2.28 | .338 |
| | 7/16 | 2.375 | *0.680 | 474 | 3.40 | .200 | *0.720 | 569 | 3.00 | .240 | *0.770 | 682 | 2.67 | .288 |
| | 1/2 | 2.250 | *0.710 | 698 | 4.39 | .162 | *0.745 | 838 | 3.84 | .194 | *0.780 | 1005 | 3.35 | .233 |
| | 9/16 | 2.125 | *0.750 | 980 | 5.68 | .132 | *0.775 | 1175 | 4.89 | .159 | *0.810 | 1411 | 4.26 | .190 |
| | 5/8 | 2.000 | *0.795 | 1323 | 7.29 | .109 | *0.820 | 1587 | 6.27 | .131 | *0.845 | 1904 | 5.38 | .157 |

* Values given in terms of lead, $L$.

## Table B—Selection of Springs

| Spring O. D. In. | Wire Dia. In. | Spring I. D. In. | Low Stress Group | | | | Medium Stress Group | | | | High Stress Group | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Coils Per In. | Safe Load *P* Lb. | Spring Ratio *R* | Defl. Per Coil *f* In. | Coils Per In | Safe Load *P* Lb. | Spring Ratio *R* | Defl. Per Coil *f* In. | Coils Per In. | Safe Load *P* Lb. | Spring Ratio *R* | Defl. Per Coil *f* In. |
| | .2253 | 3.049 | 1 | 68.8 | 1.53 | .652 | 7/8 | 84.6 | 1.43 | .800 | 3/4 | 101 | 1.39 | .960 |
| | .2437 | 3.013 | 1 1/8 | 78.8 | 1.65 | .537 | 1 | 94.6 | 1.55 | .644 | 7/8 | 114 | 1.48 | .773 |
| | 1/4 | 3.000 | 1 1/8 | 85.0 | 1.71 | .520 | 1 | 102 | 1.60 | .624 | 7/8 | 123 | 1.53 | .749 |
| | .2625 | 2.975 | *0.800 | 98.3 | 1.64 | .488 | *0.905 | 118 | 1.55 | .585 | *1.010 | 142 | 1.48 | .702 |
| | .283 | 2.931 | *0.770 | 123 | 1.74 | .441 | *0.870 | 147 | 1.63 | .532 | *0.985 | 177 | 1.54 | .639 |
| 3 1/2" | 5/16 | 2.875 | *0.740 | 165 | 1.90 | .389 | *0.825 | 198 | 1.77 | .467 | *0.940 | 224 | 1.64 | .575 |
| | .331 | 2.838 | *0.730 | 195 | 2.03 | .360 | *0.805 | 234 | 1.86 | .432 | *0.930 | 237 | 1.66 | .560 |
| | .3625 | 2.775 | *0.715 | 255 | 2.25 | .317 | *0.780 | 306 | 2.05 | .381 | *0.900 | 281 | 1.74 | .518 |
| | 3/8 | 2.750 | *0.715 | 282 | 2.36 | .303 | *0.775 | 338 | 2.13 | .363 | *0.865 | 367 | 1.89 | .457 |
| | .3938 | 2.712 | *0.715 | 325 | 2.54 | .282 | *0.770 | 390 | 2.28 | .338 | *0.855 | 406 | 1.96 | .436 |
| | 7/16 | 2.625 | *0.725 | 443 | 3.00 | .242 | *0.770 | 531 | 2.65 | .290 | *0.840 | 468 | 2.07 | .406 |
| | 1/2 | 2.500 | *0.745 | 653 | 3.80 | .196 | *0.785 | 784 | 3.33 | .236 | *0.830 | 637 | 2.38 | .349 |
| | 9/16 | 2.375 | *0.780 | 918 | 4.82 | .162 | *0.815 | 1102 | 4.20 | .194 | *0.830 | 941 | 2.94 | .283 |
| | 5/8 | 2.250 | *0.820 | 1243 | 6.09 | .135 | *0.850 | 1491 | 5.26 | .162 | *0.850 | 1322 | 3.65 | .233 |
| | .2437 | 3.263 | 1 | 73.8 | 1.60 | .627 | 7/8 | 88.5 | 1.52 | .752 | 13/16 | 106 | 1.36 | .903 |
| | 1/4 | 3.250 | 1 | 79.5 | 1.65 | .607 | 7/8 | 95.5 | 1.57 | .729 | 13/16 | 115 | 1.41 | .875 |
| | .2625 | 3.225 | *0.890 | 92.0 | 1.56 | .572 | *1.020 | 111 | 1.49 | .686 | *1.170 | 133 | 1.42 | .823 |
| | .283 | 3.184 | *0.855 | 115 | 1.65 | .519 | *0.970 | 138 | 1.56 | .623 | *1.110 | 166 | 1.48 | .748 |
| | .3065 | 3.137 | *0.820 | 146 | 1.75 | .468 | *0.925 | 175 | 1.65 | .562 | *1.050 | 210 | 1.56 | .675 |
| | 5/16 | 3.125 | *0.815 | 151 | 1.79 | .457 | *0.915 | 185 | 1.67 | .548 | *1.040 | 222 | 1.58 | .658 |
| | .331 | 3.088 | *0.795 | 183 | 1.88 | .423 | *0.890 | 219 | 1.75 | .508 | *1.000 | 263 | 1.64 | .609 |
| 3 3/4" | .3625 | 3.025 | *0.775 | 239 | 2.07 | .374 | *0.855 | 287 | 1.91 | .449 | *0.955 | 341 | 1.77 | .539 |
| | 3/8 | 3.000 | *0.770 | 264 | 2.16 | .357 | *0.845 | 317 | 1.97 | .429 | *0.910 | 380 | 1.83 | .514 |
| | .3938 | 2.962 | *0.765 | 305 | 2.30 | .333 | *0.835 | 366 | 2.09 | .400 | *0.920 | 439 | 1.92 | .480 |
| | 7/16 | 2.875 | *0.770 | 415 | 2.69 | .287 | *0.825 | 499 | 2.40 | .344 | *0.895 | 598 | 2.17 | .413 |
| | 1/2 | 2.750 | *0.785 | 611 | 3.35 | .234 | *0.830 | 736 | 2.95 | .281 | *0.885 | 883 | 2.62 | .338 |
| | 9/16 | 2.625 | *0.815 | 863 | 4.20 | .194 | *0.850 | 1036 | 3.65 | .233 | *0.900 | 1243 | 3.22 | .280 |
| | 5/8 | 2.500 | *0.850 | 1170 | 5.22 | .163 | *0.885 | 1401 | 4.53 | .195 | *0.920 | 1685 | 3.93 | .234 |
| | 1/4 | 3.500 | 7/8 | 74.7 | 1.63 | .702 | 13/16 | 89.7 | 1.46 | .812 | 11/16 | 108 | 1.41 | 1.010 |
| | .2625 | 3.475 | *0.990 | 86.4 | 1.50 | .661 | *1.135 | 101 | 1.43 | .793 | *1.310 | 121 | 1.38 | .952 |
| | .283 | 3.431 | *0.945 | 108 | 1.57 | .601 | *1.075 | 130 | 1.49 | .722 | *1.235 | 155 | 1.43 | .866 |
| | .3065 | 3.387 | *0.905 | 137 | 1.67 | .543 | *1.025 | 164 | 1.57 | .652 | *1.165 | 197 | 1.49 | .782 |
| | 5/16 | 3.375 | *0.895 | 145 | 1.69 | .530 | *1.010 | 174 | 1.59 | .636 | *1.150 | 209 | 1.51 | .764 |
| | .331 | 3.338 | *0.870 | 172 | 1.77 | .492 | *0.980 | 206 | 1.66 | .590 | *1.110 | 247 | 1.57 | .708 |
| 4" | .3625 | 3.275 | *0.840 | 225 | 1.93 | .436 | *0.940 | 270 | 1.80 | .523 | *1.050 | 324 | 1.67 | .628 |
| | 3/8 | 3.250 | *0.830 | 248 | 2.00 | .416 | *0.925 | 298 | 1.85 | .499 | *1.030 | 357 | 1.72 | .599 |
| | .3938 | 3.212 | *0.820 | 287 | 2.11 | .389 | *0.905 | 344 | 1.94 | .467 | *1.010 | 413 | 1.80 | .560 |
| | 7/16 | 3.125 | *0.815 | 391 | 2.43 | .336 | *0.885 | 469 | 2.20 | .403 | *0.970 | 563 | 2.01 | .483 |
| | 1/2 | 3.000 | *0.825 | 578 | 2.99 | .276 | *0.880 | 694 | 2.66 | .331 | *0.945 | 832 | 2.38 | .397 |
| | 9/16 | 2.875 | *0.850 | 815 | 3.70 | .230 | *0.895 | 977 | 3.24 | .276 | *0.950 | 1173 | 2.87 | .331 |
| | 5/8 | 2.750 | *0.880 | 1106 | 4.51 | .194 | *0.920 | 1327 | 3.95 | .233 | *0.965 | 1593 | 3.46 | .279 |
| | .283 | 3.931 | *1.110 | 96.4 | 1.45 | .781 | *1.320 | 116 | 1.40 | .941 | *1.520 | 139 | 1.35 | 1.129 |
| | .3065 | 3.887 | *1.090 | 122 | 1.54 | .708 | *1.240 | 146 | 1.46 | .850 | *1.430 | 175 | 1.40 | 1.020 |
| | 5/16 | 3.875 | *1.070 | 129 | 1.54 | .693 | *1.230 | 155 | 1.48 | .832 | *1.410 | 186 | 1.41 | .998 |
| | .331 | 3.838 | *1.040 | 153 | 1.62 | .644 | *1.180 | 184 | 1.53 | .773 | *1.350 | 221 | 1.46 | .927 |
| | .3625 | 3.775 | *0.990 | 201 | 1.73 | .573 | *1.120 | 241 | 1.63 | .687 | *1.270 | 289 | 1.51 | .825 |
| | 3/8 | 3.750 | *0.975 | 222 | 1.78 | .548 | *1.100 | 266 | 1.67 | .658 | *1.240 | 320 | 1.57 | .789 |
| 4 1/2" | .3938 | 3.712 | *0.960 | 256 | 1.87 | .511 | *1.070 | 308 | 1.74 | .616 | *1.210 | 369 | 1.61 | .739 |
| | 7/16 | 3.625 | *0.925 | 350 | 2.08 | .445 | *1.030 | 420 | 1.93 | .534 | *1.140 | 504 | 1.78 | .641 |
| | 1/2 | 3.500 | *0.920 | 518 | 2.49 | .369 | *0.995 | 622 | 2.25 | .443 | *1.080 | 746 | 2.03 | .532 |
| | 9/16 | 3.375 | *0.930 | 732 | 3.00 | .310 | *0.990 | 878 | 2.66 | .372 | *1.070 | 1054 | 2.39 | .447 |
| | 5/8 | 3.250 | *0.950 | 995 | 3.60 | .264 | *1.000 | 1194 | 3.16 | .317 | *1.070 | 1433 | 2.82 | .380 |
| | 5/16 | 4.375 | *1.280 | 117 | 1.46 | .877 | *1.470 | 140 | 1.40 | 1.052 | *1.700 | 168 | 1.35 | 1.263 |
| | .331 | 4.338 | *1.230 | 139 | 1.51 | .817 | *1.410 | 166 | 1.44 | .981 | *1.630 | 200 | 1.39 | 1.177 |
| | .3625 | 4.275 | *1.160 | 181 | 1.59 | .729 | *1.320 | 218 | 1.51 | .875 | *1.520 | 261 | 1.45 | 1.049 |
| | 3/8 | 4.250 | *1.140 | 200 | 1.64 | .697 | *1.290 | 240 | 1.54 | .836 | *1.480 | 288 | 1.48 | 1.003 |
| 5" | .3938 | 4.212 | *1.110 | 232 | 1.69 | .655 | *1.260 | 278 | 1.60 | .786 | *1.430 | 334 | 1.52 | .944 |
| | 7/16 | 4.125 | *1.070 | 316 | 1.88 | .571 | *1.190 | 380 | 1.74 | .685 | *1.340 | 456 | 1.63 | .822 |
| | 1/2 | 4.000 | *1.030 | 469 | 2.16 | .476 | *1.130 | 563 | 1.98 | .571 | *1.250 | 676 | 1.82 | .686 |
| | 9/16 | 3.875 | *1.020 | 664 | 2.53 | .403 | *1.100 | 796 | 2.28 | .483 | *1.200 | 955 | 2.07 | .580 |
| | 5/8 | 3.750 | *1.030 | 903 | 2.99 | .345 | *1.100 | 1084 | 2.66 | .414 | *1.180 | 1301 | 2.38 | .497 |

* Values given in terms of lead, *L*.

# DRAWN AT LOW COST

## *from Scovill Ingenuity*

Many manufacturers have found that Scovill's facilities for contract manufacturing can produce metal parts much more economically and advantageously than they can turn them out in their own plants.

The photograph here shows characteristic jobs, including parts for electric light sockets, lipsticks, broadcasting tubes, automatic pencils, refrigerator drains, ash trays, air conditioning machines, bath sprays, dime banks, etc.

Swiftly, economically, and with uniform high quality, these are made to measure and furnished either partially fabricated or mechanically complete.

SCOVILL
*Masters of Metal*

Scovill will be glad to discuss with you this matter of made-to-order manufacturing and how it may be profitably applied to your metal parts requirements. A letter to 35 Mill Street, Waterbury, Connecticut, or any Scovill office will bring you complete information.

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ABOUT OUR

# AUTHORS AND CONTRIBUTORS

S. KEILIEN

**S. Keilien** presents in this issue an article entitled, "Improving Products Through Research and Tests for Quality," which describes the progress made in the design and performance of wiring devices through systematic research for improvement.

Mr. Keilien is a graduate from Syracuse University, from which institution he received the degree of Electrical Engineer. Since graduating he has devoted himself to industrial research and development in the field of electric clocks, electric cost accounting and tabulating machines, switches, signaling and control apparatus. He has spent two years in Russia as a consulting electrical engineer. Several of his articles have been published in technical magazines. At present he is associated with Pass & Seymour, Inc., of Syracuse, N. Y., and is engaged in the research and development of wiring devices.

**Leonid M. Tichvinsky,** author of the article on "Heavy-Duty Bearing Lubrication," received the degree of Mechanical Engineer after six years of study at the Prague Polytechnic Institute in Czechoslovakia. Since 1929 he has been associated with the Westinghouse Electric & Manufacturing Company, where he is in the research laboratories in charge of work on lubrication, friction and wear of metals.

LEONID M. TICHVINSKY

JAMES SORENSON

WALLACE GATES

**James Sorenson and Wallace Gates** jointly present in this issue the article, "Machinability of Steels." Both men are employed by The Four Wheel Drive Auto Company.

Mr. Sorenson studied mechanical engineering at Chicago Technical College, chemistry at Marquette University, and metallurgy through the extension division of Pennsylvania State College. Early in his career he was associated with Gemco Manufacturing Company as metallurgist. During the war he was engineer of tests on cannon forgings in the U. S. Ordnance Department, after which he took up his duties as metallurgist with the FWD Auto Company.

Mr. Gates was graduated from the University of Wisconsin with the degree of Bachelor of Science. For the past year and a half he has been in charge of standards and time study.

## *Engineering In Washington*

EVENTUAL revision of the patent laws seems inevitable. Some change, perhaps far-reaching, may be made by the coming session of congress. Reliable observers guess three possibilities: (1) The protection period might be reduced to less than 17 years; (2) The law might be changed so that the protection period would begin at the time of registration instead of at date of issue; (3) A tax might be imposed; non-payment would automatically lapse the patent.

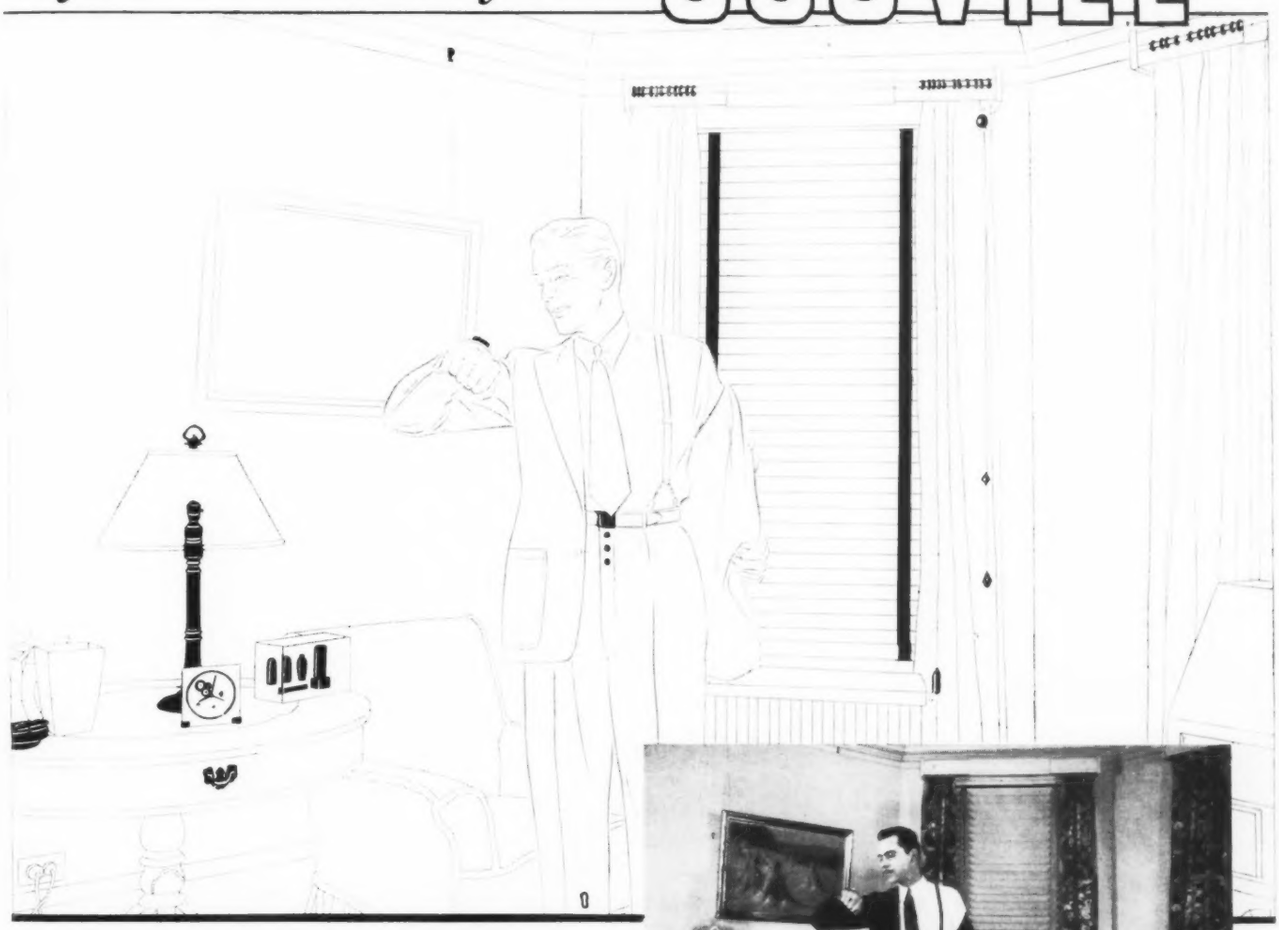
Designers and manufacturers cannot rely on these Washington guesses or on any of their own, in making their plans. They cannot know or reliably calculate what will happen until the O'Mahoney Committee's recommendations have been received and acted upon by congress.

The Administration poses the question whether existing patent rights have ceased to contribute to the public interest with the passing of the pioneer period of industrial development. And, the Administration assumes that the public is for patent law revision on the ground that many people feel that they could get into small business for themselves if the big "monopolies" did not have it all sewed up. Likewise, the Administration believes that the public believes that many patents are suppressed in the interest of industry, thus keeping off the market many products that would serve better, at lower prices.

Two conflicting reasons are given why the Temporary National Economic Committee chose for their first investigation, automobiles and gob glass. One is that it wanted to show that, under the same law, both good and evil could prosper. The automobile patent pool represents good, and the glass patent monopoly represents evil. The other reason suggested is that both autos and glass are compact industries, that is, neither of them is engaged in making a variety of products, which would vastly complicate both evidence and conclusions.

The government has long considered breaking the patent pools and cross-licensing. Last year it made a gesture toward compulsory licensing, but was stumped by the cold logic that you cannot force a "reasonable" agreement between lessee and lessor, or any two contending parties. On the assumption that patent monopoly was granted in the Constitution as a reward for creative achievement in science and art, the government now seems to be questioning whether 17 years exclusive control is too much reward. The question whether any extensive change would be in the public interest, and if so what kind of change, is indeed a perplexing one.

# . . you'll live all day with SCOVILL



You'll live all day with metal or metal things that Scovill makes. There may be a half dozen or more in your bedroom — parts of the clock, radiator valves, the belt-buckle grip, the metal parts in your Venetian blinds, or "Grippers" on your shorts. They are in your razor, your plumbing, the toaster on your breakfast table, your car, your office-building elevator.

For thousands of small metal articles are made to order by Scovill as special products for sale only to manufacturers whose names appear on the products.

Many of them may be supplied by Scovill as "staple" goods — brass, bronze, or nickel silver — in sheet, rod, wire, or tubing . . . screw products . . . a wide variety of plumbers' brass goods . . . and so on. But often they are made to meet the individual requirements of the customer.

## *Small Articles*

Many manufacturing concerns come to Scovill for their metal parts rather than produce the items themselves. Scovill's engineering talent and the variety and quantity of Scovill equipment frequently permit either a more satisfactory cost or a product betterment.

Keep in mind Scovill's products — and Scovill's facilities — when considering the practical aspects of your designs. Many of America's leading designers do — and find it highly profitable.

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ABOUT OUR

# AUTHORS AND CONTRIBUTORS

**Douglas F. Miner,** author of the article "Testing New Materials," was formerly manager of the Central Engineering Laboratories and Standards of the Westinghouse Electric & Mfg. Company. He was recently appointed consultant to the company.

Mr. Miner attended Clark College at Worcester, Mass., graduating with majors in biology and psychology in 1912. Deciding then that his greatest interest was in engineering, he entered the Worcester

DOUGLAS F. MINER

Polytechnic Institute and was graduated with the degree of Bachelor of Science in electrical engineering. He remained at that institution for two years as a cooperative Westinghouse research assistant, doing post-graduate work. During the war Mr. Miner enlisted in the Coast Artillery, and served one and a half years in France, completing his Army service in June 1919 with the rank of Captain.

During the earlier part of his career at Westinghouse, Mr. Miner worked principally in research and development. His activities included the development of a crest voltmeter for high voltage measurement, the introduction and development of voltage doubling surge generators of high voltage, and projection welding, as well as several other technical studies. More recently he has been concerned with standardization and coordination of materials in all Westinghouse plants. In this connection he prepared a handbook of data on materials and parts for Westinghouse.

**C. B. F. Young** has prepared for *Product Engineering* an interesting and practical series of articles dealing with the coloring of metals by chemical and electrochemical methods. The first article appears in this issue.

Dr. Young was graduated from Howard College with the degree of B.S. in Chemical Engineering, was then appointed as an assistant in the department of chemistry at Columbia University, from which he received his M.S. and Ph.D. degrees.

In 1934 Dr. Young was appointed technical director of the U. S. Research Corporation, Long Island City, from

C. B. F. YOUNG

which position he has lately resigned to enter the consulting and teaching field. He is president of the Institute of Electrochemistry and Metallurgy, and instructor at Brooklyn Polytechnic Institute, and also engaged in consulting work. Dr. Young is the author of "Practical Electroplating," dealing with electrochemistry, metallurgy and chemical engineering.

**W. A. Thomas** has worked jointly with T. C. Lloyd in the preparation of the article, "Induction Motors for Frequent Starting and Rapid Reversal." Mr. Lloyd through his contributions to *Product Engineering* is known to our readers.

W. A. THOMAS

Professor Thomas, a graduate of the Case School of Applied Science, after working with the General Electric Company in the test department took up teaching as a career. He has served as instructor at Case, as laboratory instructor at Yale University from which institution he received the degree of Doctor of Engineering. He was also Assistant Professor of Electrical Engineering at Antioch College. At present he is Assistant Professor of Electrical Engineering at Iowa State College.

An article "Negative-Sequence Reactance of Synchronous Machines" written by Professor Thomas appeared in the December 1937 number of *Electrical Engineering*. At present he is directing a research project on factors that contribute to noise in small motors under auspices of the Engineering Experiment Station of Iowa State College.

## *Engineering in Washington*

HEARINGS before the Temporary National Economic TNEC, or Monopoly Committee as it is popularly called, reopened on January 16 and have been productive of a great deal of data and opinion about the patent situation. The lead article in this number of *Product Engineering* gives a summary of the testimony and unofficial suggested changes in the patent laws. Highlights of the hearings, which ended on January 20, included the recommendations made by Patent Commissioner Coe, the evidence relating to "suppression" of radio tube patents, and the "scandal" concerning the patent "monopoly" in glass-container making machinery. "But," say some observers, "It is doubtful that Congress is interested in patent law changes because not enough voters are, and the necessary agitation to create interest is not forthcoming. At least it never has been in the past." But in this present agitation the President and the Department of Justice are taking a hand, which puts a different light on the subject.

Recognition of engineering design came in a big way when the National Advisory Committee for Aeronautics took steps to ask Congress for increased funds to expand its research work at Langley Field, the government's central air laboratory. In its annual report to Congress the NACA explained that if the United States is to maintain its technological leadership in aviation it must increase its research programs. "Air power is primarily dependent not only upon numbers of airplanes, but the airplanes themselves must have performance equal to those of any enemy." The study being made of urgent needs in airplane design for the future is going ahead and will, it is explained, be completed soon.

# 42 PARTS MAKE A CUP DISPENSER

## *A hint on solving production problems*

THIS brilliantly chromium plated paper cup dispenser, the product of a nationally known paper goods Company, is engineered to their specifications by Scovill.

Forty-two parts are required. The drawn brass lower shell and top shell are particularly accurate. The teardrop design is carefully controlled to insure an even, symmetrical appearance.

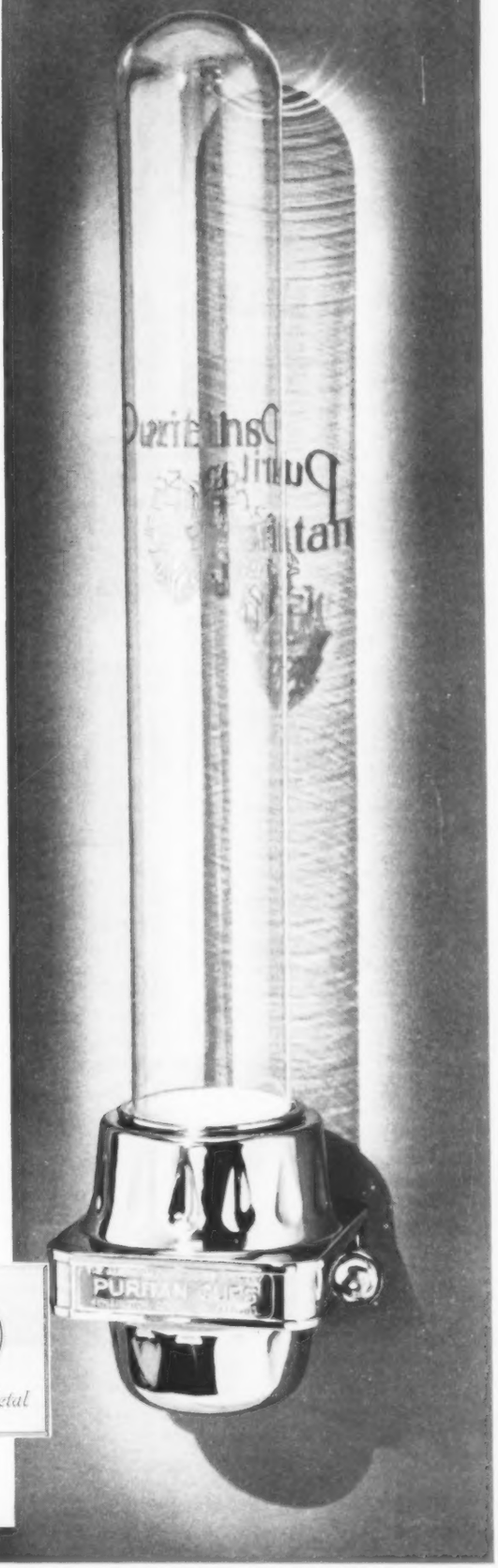
The center name plate band is stamped from brass sheet formed to shape, but has all the appearance of a seamless drawn shell, as the joint is completely concealed.

The fifteen working parts in the dispensing mechanism are zinc die castings. These fifteen parts all function together to separate one cup from the stacked supply —then dispense it easily and certainly. In addition to accuracy in the parts, the final assembly and adjustment must be delicately handled to provide an exact, easy working motion. Scovill Phillips screws are used in the assembly.

The complete dispenser is attractive in appearance, well planned and designed by the customer, then finely, but economically, made by Scovill.

It is a top example of modern production coordination that can go to work on *your* products.

Scovill's facilities are diversified, their skill wide, as many a manufacturer has found to his advantage. Get in touch with Scovill on your requirements for metal parts or products, screw products, non-ferrous forgings or brass mill products in sheet, rod, wire, and tubing. Why not write today for your free copy of "MASTERS OF METAL", a booklet further describing these facilities?

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# AUTHORS AND CONTRIBUTORS

Left to Right:
A. C. Rasmussen
Thomas Barish
Harold G. Beebe
C. H. Whitlock

**A. C. Rasmussen** presents in this issue the second part of his article in which gear tooth formulas that take into account beam strength, dynamic loading and wear factors are developed. Part one appeared in the February number. His best known contribution to *P. E.* was his series on "Friction Clutch and Brake Design" which started in the December 1931 number.

Mr. Rasmussen was graduated from Rose Polytechnic Institute with a B.S. degree and later received the degrees of M.S. and C.E. from the same institute. Upon graduation he went with the Insley Manufacturing Corporation where he has designed construction equipment of various types, ranging from steel frame structures to power-driven excavators. He is now vice-president and chief engineer of the company.

**Thomas Barish,** assistant chief engineer of Marlin-Rockwell Corporation, in this issue contributes his second article to *Product Engineering*. A graduate of Columbia University, B.S. *cum laude* in mathematics in 1917 and M.E. in 1920, he also taught in the astronomy department of Columbia. From 1920 to 1925 he was in the engineering department of SKF Industries; and in 1925 joined Marlin-Rockwell. He has written numerous articles on ball bearing design and applications, and has presented a number of papers before technical societies, including the A.S.M.E., S.A.E. and A.G.M.A. He has done extensive research work on high-precision and high-speed anti-friction bearings.

**Harold G. Beebe,** who presents in this issue an article dealing with the properties and applications of ceramics in mechanical and electrical apparatus, was graduated from Union College with the degree of bachelor of science in electrical engineering. After graduation he did development work at the General Electric Company on the first commercial heterodyne receiver. Later he entered the employ of the Radio Corporation of America and became service manager of their Atlanta office. Since 1933 Mr. Beebe has been associated with Isolantite Incorporated where he is at present sales manager. While with this company he has been active in developing coaxial transmission lines.

**C. H. Whitlock,** author of the article "Plastic Over Metal," has had eleven years experience in the plastic industry. After attending the University of Rochester, he spent four years with Samson United Corporation, Rochester, N. Y., designing electrical appliances. He entered the plastic field in 1928 when he became associated with Norton Laboratories, Inc., Lockport, N. Y., becoming vice-president of that company in 1935. He left Norton in 1936 and took a sales engineering position with General Industries, Elyria, Ohio. He has been with The Firestone Tire & Rubber Company for the past year, heading sales engineering in the plastic division.

## *Engineering in Washington*

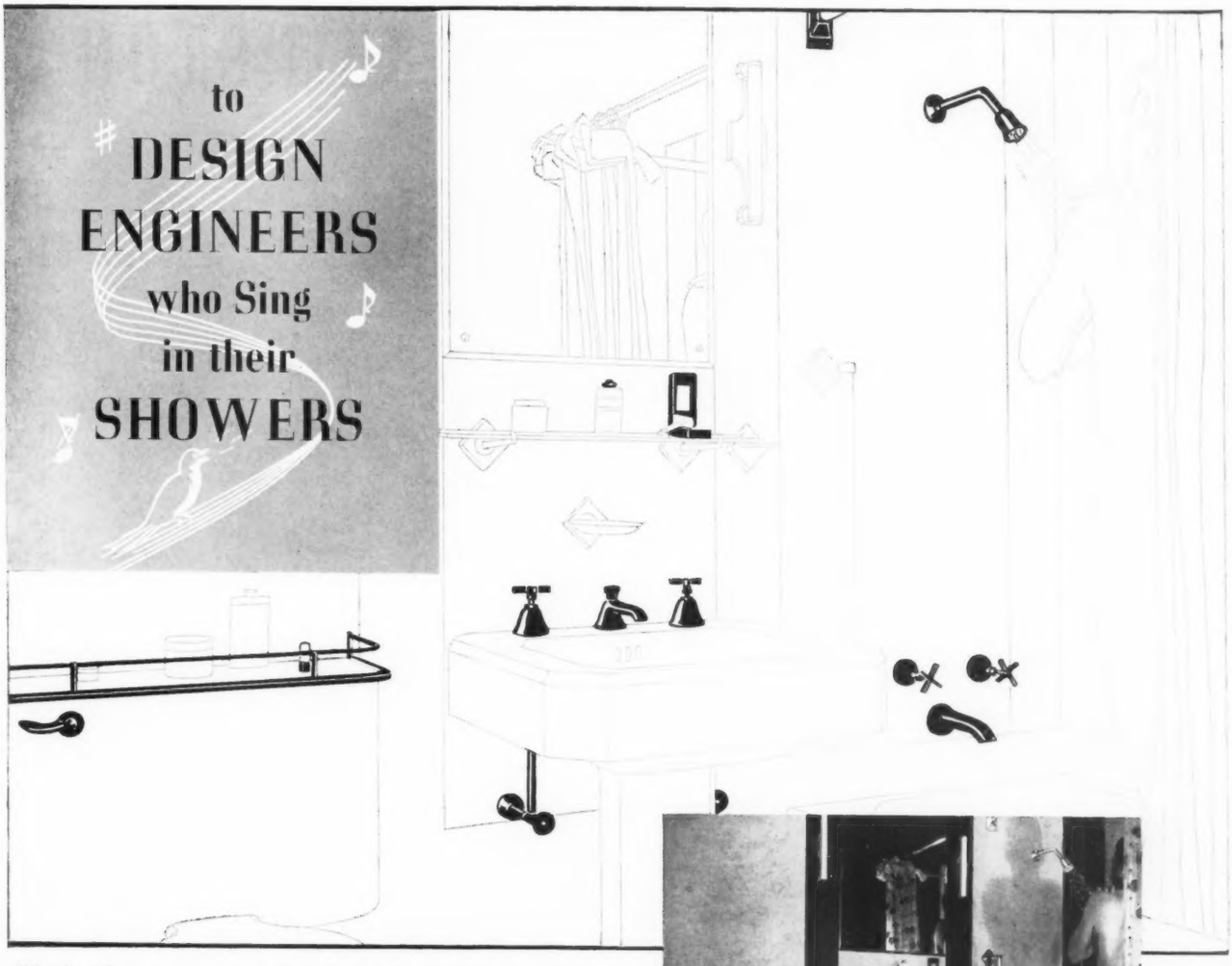
PATENT LAW REVISION has moved off the Washington stage and is going on back in the dressing rooms. No one will admit that any bills are being written, but being written they are. Reliable patent observers here say that the bills will incorporate most of the recommendations of Commissioner Conway P. Coe. In any case it is not probable that legislation will be in any way drastic. There will be no compulsory licensing.

Though the fact may bring dismay to the peace-minded, product design will shift more and more to war machines. New armaments of all kinds: rifles, rapidfire guns, anti-tank and anti-aircraft guns, new bombs and ammunition, faster airplanes, motorization for mobile equipment, better searchlights, better short-wave radio, more powerful turbines and drives for navy ships, torpedo boats, and other fighting gear must be produced. All these are included in army and navy expansion laws and bills. Of special interest to engineers is the $34,500,000 that surely will be voted, to be spent during the next three years, for "educational orders" by the war department to give manufacturers better than blueprint experience in making critical munitions.

National Advisory Committee for Aeronautics is asking congress for $2,140,000 for expansion of its laboratory at Langley Field, Va., and also asks for $10,000,000 to construct another research station at Sunnyvale, Calif., to serve the west coast section of the industry, which now builds about 60 per cent of the country's total production.

For some years a new school of design in the navy has contended mightily for high temperature-high pressure steam, while the old school hauled back. High-pressure high-temperature turbines were installed in the destroyer Benham. Recent newspaper scare heads announced discovery of "serious defects." But unpublished facts are that the destroyer Benham's turbine fault, discovered when her covers were lifted after "shake-down" trip, were merely trivial, incidental to development in high temperature-high pressure practice. The Benham ran one of the most successful tests ever known in the department. Navy is now far ahead of general marine practice in high temperature-high pressure, yet is nowhere near up to general stationary practice ashore. Those two facts, officers feel, indicate a sound position. There is every indication that the "highs" are about to have it.

# to DESIGN ENGINEERS who Sing in their SHOWERS



We'd like you as full of good spirits at your drawing-board — content in knowing your problems in metal can be capably looked after by Scovill. Plentiful examples of Scovill's versatility can be found right in your bathroom — metal parts made to order exclusively for some other manufacturer or staple products sold throughout a field.

Among them — parts for your weighing scale, parts for your blade-type or electric razor, your toothbrush container, the cap on your shaving lotion bottle, the socket shells in your electric lights, etc.

***Parts Made to Order from Base Metal***

You may design airplanes or radio sets or sewing machines . . . still Scovill can probably help you, for Scovill serves industry as an efficient source of supply for containers and closures . . . forgings . . . fabricated metal assemblies . . . screw products . . . drawn shells . . . stampings . . . multiple plunger machine parts — and similar quantity-ordered products. Also well served are customers who purchase Scovill sheet, rod, wire and tubing in brass, bronze and nickel silver for use in their own cutting-up plants.

*"Masters of Metal," describing these facilities and outlining briefly how they have been used to advantage by other leading manufacturers, will be sent you upon request to 35 Mill St., Waterbury, Conn.*

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# ENGINEERING IN WASHINGTON

McGRAW-HILL WASHINGTON BUREAU
Blaine Stubblefield, Special Correspondent

ALL DOUBT as to the success of high-pressure high-temperature steam installations in a number of the newer naval vessels was dispelled when Admiral William D. Leahy, retiring chief of operations, told a group of news men in Washington that all the ships performed perfectly during the whole period of the Caribbean naval maneuvers, with no failures and no derangement of boilers, that he knew of. The Admiral admitted that he had been a little uncertain about the change when installations were being made. He said the Navy will stabilize on the new high pressure-temperature until shore installations prove the practicability of still higher ranges, when the fleet will again move.

* * *

RECENT WIND TUNNEL TESTS at the Langley Field air laboratories of National Advisory Committee for Aeronautics have shown that surprising reduction of drag can be accomplished by smoothing the skin structure of metal clad airplanes. Smoothing consists of counter-sinking rivet heads, making welded butt-joints instead of laps, and eliminating wrinkles and protuberances. Manley J. Hood, assistant engineer with NACA, read a paper before S.A.E., meeting in Washington, in which he stated that rivet heads on a large plane necessitated as much as 180 extra horsepower and 270 pounds of extra engine and propeller weight, plus 860 pounds extra fuel, and tank space, during a 10-hour flight. This correspondent, discussing the subject further with NACA officials, is convinced that they consider reduction of skin friction of added importance, as both civil and military aviation enter an era of higher speeds. Other methods of smoothing are being studied, but the three mentioned are in general practice.

* * *

WHILE OTHER COUNTRIES build highly efficient military airplanes, with full striking power but with low durability at low cost, the United States continues to copy the high-precision tradition of the Ordnance school, building units good for 10 or 15 years service, at tremendous and constantly increasing cost. Congress is objecting to the mounting expense, and military authorities ask what is the use of machine gun accuracy at such cost, when designs are obsolete by the time the order is on the line. They say that both aircraft and pilots in aerial warfare are more and more regarded as expendible munitions. The answer may be a partial return to steel, wood and fabric construction.

* * *

DESIGNERS will not have to contend with substitutes for critical, strategic metals in the next war if a bill is passed by Congress authorizing expenditure of $25,000,000 a year during the years 1940-41-42-43 for accumulation of stocks, under joint direction of the Secretaries of War and Navy. The War-Navy-Munitions Control Board would determine which materials to purchase and store. Most would be imported, of course. The measure has been reported favorably by the Senate Military Affairs Committee.

* * *

THE BUREAU OF STANDARDS Standing Committee in charge of Simplified Practice Recommendation R62, Metallic Cartridges, has approved the second revision of the recommendation. One hundred fifty items are listed, a reduction of approximately 23 per cent from the number in the current issue, and compares with 348 varieties of metallic cartridges listed prior to the establishment of this recommendation. Merging of Center-Fire Pistol and Center-Fire Rifle Cartridges is provided.

* * *

INTRODUCTION OF PATENT LAW REVISION is waiting on the preliminary report of the Temporary National Economic (Anti-trust) Committee, which is expected in the near future. Undoubtedly the report will include patent recommendations. It looks as if Rep. William I. Sirovich, chairman of the House Patents Committee, and Patent Commissioner Conway P. Coe, are waiting for the report, after which they will introduce their bill. Coe and Sirovich seem to be in agreement on what is needed. In case the TNEC does not make recommendations, observers believe the legislation will be offered anyway, either by Sirovich or by certain members of TNEC or other Congressmen. The bill would follow the lines of Coe's testimony before the Committee.

# IN THIS ISSUE

A recent discussion of qualifications for engineers stated that one important requisite was to be able to find the desired data and information. Unfortunately, much of the engineering information is scattered; much is never published. With these two things in mind, *Product Engineering* has taken upon itself the task of unearthing and assembling data and information of special design value and editing this for presentation in condensed and convenient form. For the past years, every number of *Product Engineering* has included four or more pages of such "designer's reference sheets."

Over a period of a year more material of reference nature has been collected than could be included in regular numbers. Also, many readers have requested compilation of certain specific information and many more have expressed themselves regarding the great value they attach to *Product Engineering's* "design reference sheets." For these reasons it was decided to devote an entire issue to material of this nature and thus it came about that this April number of *Product Engineering* is devoted entirely to design work sheets.

In planning the scope and content of this April number, the aim was to cover as great a variety of subjects and as many types of design problems as possible in order to make certain that every reader would obtain a goodly number of reference articles that pertained specifically to his kind of work.

A total of fifteen subjects are treated on the following pages. Each article confines itself as much as possible to specific design data and information and the diversity of subjects included ranges from plastics to steel castings and from bearings to complete automatically controlled drives.

Also included in this issue is our 1939 Classified Directory which lists under appropriate headings sources of supply for materials, electrical and mechanical parts and finishes which are specified by designing engineers.

The editors will appreciate criticisms and comments and will particularly welcome suggested topics to be treated in future numbers of *Product Engineering*.

# TILTING PROFITS

*into a Manufacturer's Till*

A MANUFACTURER of Venetian blind hardware had been equipping his product with a standard tilting device which he manufactured. Some of the parts he made complete within his own organization — some he purchased.

He discussed with Scovill the possibility of simplifying manufacturing procedure. Working in close cooperation with the customer several economies were found possible. One screw machine product was changed to a cold headed part — two screw machine products were redesigned and assembling greatly simplified. The complete job is shown above.

Result — this manufacturer now has a tilting mechanism more *efficient, yet actually costing him less.*

In this case, Scovill's Screw Products Division worked out the improvement, but Scovill's facilities are wide, as many a manufacturer has found to his advantage when he has come to Scovill with his production problems.

We would welcome the opportunity of working with you to help increase your profits by simplifying your production operations and lowering your costs. May we hear from you? Please address 35 Mill Street, Waterbury, Conn.

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# ENGINEERING IN WASHINGTON

McGRAW-HILL WASHINGTON BUREAU, *PAUL WOOTON, CHIEF*

AMERICAN AIRPLANE EFFICIENCY and performance is being kept ahead of German designs at the Wright Field Air Corps' development laboratory by burning the midnight oil because metal-working companies are again busy at the "past-time" of raiding each other's engineering staffs.

When times are bad, Wright Field's civil service and steady wages pull in good men. But now, with improved conditions, and with munitions booming, private employers' cash registers play the sweetest music, and the Army goes begging for designers and tool engineers.

✦ ✦ ✦

MERCHANT SHIP DESIGN being done by the technical division of the Maritime Commission is admittedly on a high plane. During the Commission's first two years under the new ship-subsidy act, its future seemed at times in doubt because the operating companies were unable to absorb the cost of shifting from their old war-time surplus equipment, acquired dirt cheap, to the high capital structure necessary for new equipment. That condition still exists, but the government is going ahead toward its 500-ship naval auxiliary, even if federal ownership is the final outcome. This country's traditional genius for assembly line production is its only advantage in ship building against the rest of the maritime world with its low labor costs. The Commission's C-1, C-2 and C-3 steel cargo designs, steam and diesel, twin and single screw, are regarded as an excellent basis for the program.

✦ ✦ ✦

MUNITIONS AND WAR GOODS. Design, and industry will shift more and more of their energies to development of munitions and war goods, if the present trend continues. Ordnance and private manufacturers are expected to improve methods and processes, especially in metal working. As an example, engineers are experimenting successfully with rolling and welding large cartridge cases instead of deep-drawing them. They are also trying to cut them out of seamless tubing. War and Navy men point out that opportunity to contribute is open to alert small-shop men as well as to researchers in big company and government laboratories.

✦ ✦ ✦

CRACKPOT INVENTIONS are always dribbling into War, Navy and other departments, but when armament booms, they *pour* in. Trouble is that war machine experts find a good one every now and then, so they are afraid not to scan the whole lot as it slides over their desks toward the return mail department. Officially, War and Navy doesn't tell journalists about even the funniest of weapons and dirty tricks to play on the enemy. But if you come to the Capital and get cozy with an officer in the know, he will give you plenty of laughs. The best one they've told us was about a man who wanted to build super-colossal flat cars to run on four or five parallel railroads and haul the Navy from coast to coast. Another gent suggested an armed steam roller as big as all outdoors. You could flatten a city or an army with it in practically no time.

AIRCRAFT RESEARCH. National Advisory Committee for Aeronautics was turned down by Congress on its request for $10,000,000 to build a laboratory at Sunnyvale, California, in addition to its plant at Langley Field. Capitol Hill was not impressed by NACA's argument that the Coast annex was needed because more than half of the aircraft industry is there. Legislators could see no point in splitting the institution in two parts. But the Administration strongly favors additional aircraft research. Some authorities point out that Germany has not one or two laboratories, but several located in various parts of the country. NACA's request will likely be brought up again in the near future.

# *Authors and Contributors*

The mechanical design, fabrication and installation of the continuous viscose rayon spinning machine, described in detail in this number, was carried to its successful completion mainly under the guidance of two men, George P. Torrence and Richard F. Bergmann.

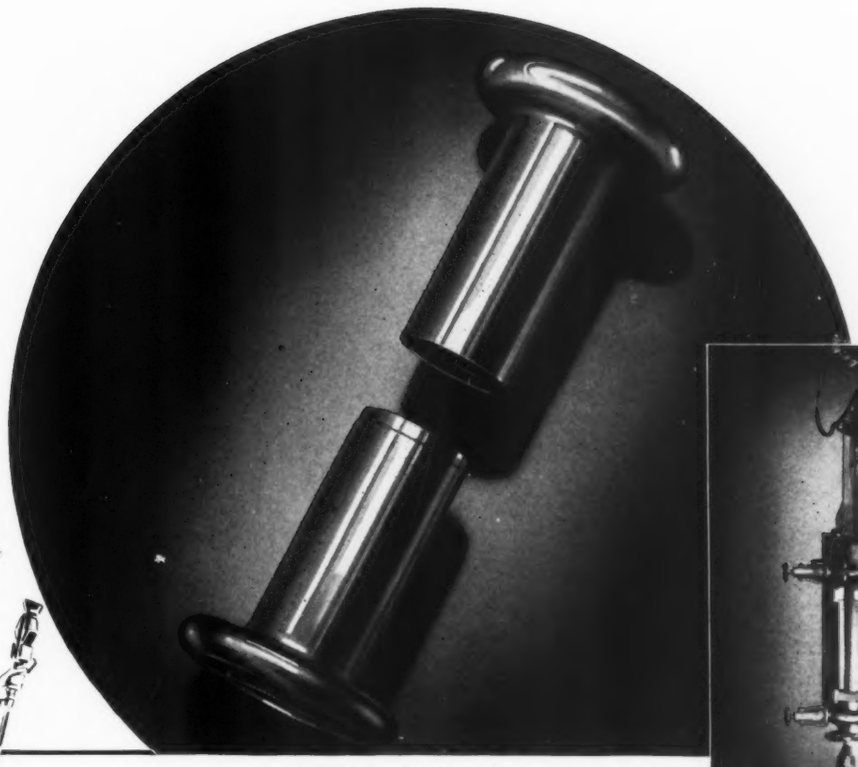
**George P. Torrence,** vice-president and general manager of Rayon Machinery Corporation, was president of the Link-Belt Company from 1932 to 1936. Shortly after resigning from this position he assumed general direction of the machine development work for Industrial Rayon Corporation and its wholly owned subsidiary.

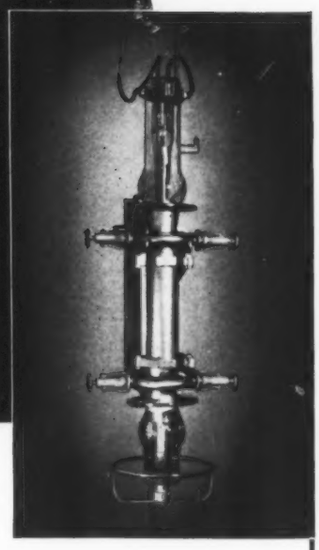
**Richard F. Bergmann,** who furnished the material on which the article is based, is chief engineer of the Rayon Machinery Corporation, and has spent his entire business career in the development of power transmission and materials handling equipment. A native of Logansport, Ind., he was graduated from Rose Polytechnic Institute at Terre Haute, Ind., in 1918, and joined the Howe Chain Company, Muskegon, Mich., after brief service as an ensign in the United States Navy during the world war. Subsequently this company was merged with the Link-Belt Company which transferred Mr. Bergmann to Chicago in 1924. He was assistant chief engineer of Link-Belt until 1936, in which year he joined Rayon Machinery as chief engineer.

RICHARD F. BERGMANN

GEORGE E. BEGGS

**George E. Beggs,** who developed the hydraulic testing machine described in the Modern Designs section, is well known for his contributions to engineering literature on methods of stress analysis in indeterminate structures by use of models. Professor Beggs received his A.B. degree from Northwestern University, and his C.E. degree from Columbia University. Since graduation he has been successively engineer with American Bridge Company, chief engineer, Phosphate Mining Company, and professor of civil engineering at Princeton University. He is the author of a book on live load stresses in railroad bridges.





*Dimensions: length 15½", diameter 3½"*

# SCOVILL hits a radio tube "on the nose"

"On the nose" — an expression that signifies correct-to-the-second timing of a radio show — could be applied to Scovill's successful completion of an exacting job for a manufacturer of electrical equipment.

A radio broadcasting tube required a water jacket made of a seamless, one-piece pure copper shell, free from imperfections and with the metal oxygen-free. The dimensions give an idea of the production difficulties: length 15½ inches, diameter 3½ inches, diameter across hollow flanged section 6¾ inches, average wall thickness .125 inch.

Scovill produced the jacket from flat one-quarter of an inch thick Oxygen-Free High Conductivity Copper. The blank is drawn, redrawn, flanged and finished cold.

Expert tool designing and building, a comprehensive knowledge of metal behavior, and the "know how" gained in many years of metal working experience enabled Scovill to turn out the job "on the nose".

Today more than 3,000 firms, relying on Scovill's manufacturing ability, complete facilities and years of experience, regularly bring their manufacturing problems to this organization.

It is quite likely that your problem in metal products or part production is one which Scovill could solve efficiently and economically. A letter to Waterbury or to any Scovill office outlining the problem will bring you an immediate and intelligent reply.

"Masters of Metal", describing Scovill facilities and outlining briefly how they have been used to advantage by other leading manufacturers, will be sent you upon request to 35 Mill St., Waterbury, Conn.

SCOVILL
*Masters of Metal*

**SCOVILL MANUFACTURING COMPANY**

**35 MILL STREET, WATERBURY, CONNECTICUT**

Boston, Providence, New York, Philadelphia, Syracuse, Pittsburgh, Detroit, Chicago, Cincinnati, San Francisco, Los Angeles. In CANADA: 334 King Street, East, Toronto, Ontario.

# ENGINEERING IN WASHINGTON

McGRAW-HILL WASHINGTON BUREAU, *PAUL WOOTON, CHIEF*

**Gold and chromium** properly alloyed is ideally suited for the construction of resistance elements for precise electrical measuring instruments, according to Bureau of Standards' tests which were started several years ago. After suitable heat-treatment the resistance of coils containing 2.1 per cent of chromium does not change more than one point in a million when the temperature changes from 64 to 95 deg. F., and over long periods the resistance of properly constructed coils is extremely stable. The resistance thermometry bridge is mentioned as an example of an instrument that will be definitely improved by the alloy.

* * *

**A new gun lining alloy** is being tested with promising results, according to fairly reliable reports from Washington. The Navy won't talk but it is said that guns with linings made of this new alloy can fire about 500 rounds before they must be taken back to the shop for relining and reboring. Present guns can fire only about 100 rounds after which they must be rebored. The lining alloy is kept a secret but people who think they're in the know have been mentioning that the new lining is an alloy with boron-carbonite additions.

* * *

**Research Facilities** for the National Advisory Committee for Aeronautics, in addition to those at Langley Field, Va., might still be authorized by congress. In case you have lost track of this in-again-out-again project, it was out, as this was written. Half a dozen bills are in the hopper for laboratories at congressmen's home towns, but Sunnyvale probably will get it, if any. Appropriation in support of any authorization that might be voted would be in the catch-all third deficiency bill. It's almost certain there will be more air laboratories—eventually, if not now.

* * *

**A high-voltage laboratory,** which will enable industry and medical science to work with x-rays at million-volt levels with much less risk of serious burns, is being built at the Bureau of Standards. With increased protection for investigators, the greater penetrating power of modern high-tension x-rays will be more useful for the medical profession in the treatment of cancer and for industry in the examination of large metal parts. In this new laboratory, ground for which has just been broken, accurate measurement of energy in the high-voltage field will be undertaken. Previous studies have been limited to about 100,000 volts. The study to be undertaken by the Bureau of Standards will begin at 230,000 volts and will be continued to higher levels. Insulation of testing will be standardized. A 2,000,000 volt surge generator will be installed.

* * *

**Beryllium** may be the most important metal in the next war in the opinion of the O'Mahoney Anti-Monopoly Committee (TNEC), which "went to town" with its exposé of international patent skullduggery. Testimony claims that Germans did the original head work, that the Americans then bought their way in, after which the British and French muscled in. It shows that if one country really wants to get valuable rights from another, it can be done by threat of reprisal. The hearings record of the Temporary National Economic Committee will be a valuable book to anybody interested in this field. It is common knowledge among metallurgists that the possibilities of beryllium as an alloying element have hardly been scratched. Up to date the most extensive developments have been in the beryllium-coppers. No commercial alloys of beryllium-nickel or beryllium-aluminum are available, although it is rumored that considerable progress has been made in beryllium-nickel alloys and that the indications are that some amazing results will be obtained.

* * *

**Airfoils** in the Boeing Stratoliner failed under the stresses developed in a test flight, according to the report of the investigation of the accident, as recently published by the Civil Aeronautics Authority. The Boeing Company follows the report with a statement that this structural failure occurred under the strain of modern testing which is much more severe than it used to be—in all probability the accident never would have happened in normal flight. With regret for loss of life and property, Boeing states that the test methods—and the disaster—will add to safety in the air. In a melancholy way the failure is a credit to sound engineering.

* * *

**Research** in engineering and business management conducted by land grant colleges will be greatly increased if some of the flock of bills now before congress proposing federal funds to land grant colleges for such research are passed. Rep. Robert A. Green says he expects favorable action this session on his bill to appropriate up to $25,000 annually to each engineering experiment station of the State's land grant schools. The money would be used for research in engineering principles, conservation of power, transportation, industrial management, uses for farm products, trade and industrial waste, and so on. Inquiry among some Washington business and engineering men reveals little support for this and similar measures. Most of the "ballyhoo" comes from deans of the schools, they say. And they express belief that investigation proposed by Mr. Green would duplicate existing work in progress and would waste public money.

* * *

**A new electric-arc** process for manufacturing synthetic rubber has recently been developed in Germany. The new process coverts to "rubber" the acetylene from waste hydro-carbons produced by synthetic gasoline plants, thus dispensing with the need of coal as a basic raw material. Germany's second largest commercial plant for producing synthetic rubber, now building in Westphalia, will use this new process instead of carbide. Authorities expect that cost will be reduced by technical improvements which will reduce the consumption of electric power, which has been the main factor of expense.

* * *

**Hydraulic buffers** used in elevator pits are being studied for their effectiveness by the Bureau of Standards. The Procurement Division of the Treasury and other federal agencies which purchase passenger elevators, will use the information in their specifications. But the Bureau's facts will be useful to all designers on decelerating problems. High speed motion picture cameras are used to determine the extent of retardation. While oil-filled buffers have proved very satisfactory, their efficiency is limited to certain load and speed ranges. For instance, a buffer might properly retard a load of 1,500 lb. at a speed of 250 ft. per min. but it might permit a dangerously sudden stoppage of 3,000 lb. at a speed of 1,000 ft. per min. It is not intended of course that buffers will supplant the usual rail grip safety device.

# DRAWN AT LOW COST

## *from Scovill Ingenuity*

Many manufacturers have found that Scovill's facilities for contract manufacturing can produce metal parts much more economically and advantageously than they can turn them out in their own plants.

The photograph here shows characteristic jobs, including parts for electric light sockets, lipsticks, broadcasting tubes, automatic pencils, refrigerator drains, ash trays, air conditioning machines, bath sprays, dime banks, etc.

Swiftly, economically, and with uniform high quality, these are made to measure and furnished either partially fabricated or mechanically complete.

Scovill will be glad to discuss with you this matter of made-to-order manufacturing and how it may be profitably applied to your metal parts requirements. A letter to 35 Mill Street, Waterbury, Connecticut, or any Scovill office will bring you complete information.

SCOVILL

*Masters of Metal*

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# ENGINEERING IN WASHINGTON

McGRAW-HILL WASHINGTON BUREAU, *PAUL WOOTON, CHIEF*

**Most dramatic engineering** in Washington this month was Navy's raising of the submarine Squalus. Only one feature of the job was strictly new. That was the jointed hydraulic "lance" for tunneling chainways under the hull. On other submarine salvages, the divers had followed bodily through the tunnels, using short nozzles, and were dangerously trapped as soil slid in behind them. The Squalus lance was curved to the hull and sections were added as it bored ahead. Sections were let down on a guide wire which of course remained inside the lance. When the lance came up on the opposite side of the hull, the wire was used to pull heavier wire under, which in turn pulled the chains under. Compressed air was tried as an impact element, but was found inadequate, as on previous occasions. The job was done with water under 250 lb. pressure, led by hose from a pump aboard the salvage ship. Sea pressure is about 107 lb. at 240 ft. A series of holes in the initial section of the lance, just back of the nozzle, allowed enough water to escape to prevent whipping under pressure increased by momentary blocking in the hard clay soil. The holes were angled backward, so that the backwash served the purpose of clearing the loosened soil from the tunnel. Many engineers have wanted to know why, after the sub is pulled clear of the mud, the water is not blown out and the boat allowed to buoy to the surface. The reason is that to blow the water out all valves would have had to be closed to keep it out. The Navy doesn't want the valves touched—wants to see just what did happen to them.

* * *

**A portable radium detector** of responding to the slightest evidence of radioactive material in an average room is reported by the Bureau of Standards. The device will help decrease accidental contamination of materials by radioactivity in plants and laboratories. It also readily locates lost particles of radium. It can measure the influence of one microgram of radium at one meter distance.

* * *

**The much-buffeted Sunnyvale** aircraft engineering project has hit another tail wind and is making time toward enactment this session. After the appropriation committee turned down the President's request for $10,000,000 to build and operate the plant, Colonel Charles Lindbergh was brought home to survey aircraft progress and bolster the need for research. His statement took immediate effect by confirming the opinion of the congressional minority that technological preparedness would be better than maintenance of a large fleet of planes which obsolesce rapidly. Chances now seem favorable that the money will be forthcoming in the third and last deficiency bill. Sunnyvale, and any other research centers that may be authorized in future, would be administered by the National Advisory Committee for Aeronautics, which now has only Langley Field, Va., under its administration.

* * *

**An anti-tank gun** that is capable of firing a 37 mm. shell which can penetrate 1½-in. armor at 3,000 ft. is reported developed by Army Ordnance. It is mounted on a field carriage; total weight 900 lb.

* * *

**Standing committees** have reaffirmed simplified practice recommendations on (1) standard number of units in packages of automotive (bus) engine parts; (2) standard unit of pack for compressor and governor parts for air brakes; (3) standard stock types and sizes (capacities) of steel barrels and drums. Copies of recommendations furnished by Superintendent of Documents, Government Printing Office, Washington, D. C.

* * *

**A coal mining company** in Germany has established the first large scale plant for producing heavy synthetic motor fuel for high speed Diesel engines, the Department of Commerce reports. The process uses as raw material a mixture of tar oils produced in the coking of bituminous coal and so-called "Kogasin II," a material produced from gasified coke, or carbon monoxide and hydrogen. These materials possess special fuel properties and, when mixed, complement each other in creating what is said in Germany to be a superior Diesel fuel similar in characteristics to gasoline and benzol when combined in light motor fuel mixtures.

* * *

**Military outlets** for production are being scanned by engineers as industry turns more and more to War and Navy Departments for orders to keep the wheels rolling. Educational orders totaling $34,000,000 will go to a great many firms entirely new to the ordnance field during the next two or three years. In addition, the War Department is now asking Congress for authority to procure aircraft by negotiation instead of bidding. If Congress approves, all eligible plants would get war plane orders, whereas the bulk of the business at the present time goes to three or four firms.

* * *

**Special machine tools** to aid in their armament program are being sought by the French mission which has come to place "commands d'instruction," the commission following about the same policy laid down by Congress in its educational orders law of last year. In addition to tools the French are interested in iron and steel, brass work, and in American metallurgy in general. They will be in the United States for one or two months to visit plants in Massachusetts, Connecticut, Vermont, Pittsburgh, Chicago and other machinery centers. Their official home during their stay will be the French embassy in Washington.

* * *

**An all-electric** slow-motion camera capable of taking 80,000 pictures per second has been developed by a German electrical firm according to report at the Department of Commerce. The machine is designed for technical research. The stroboscope subdivides individual exposures, by means of a disk of rotating lenses which eliminates the shutter. Movies of high-tension discharges and flying bullets have been made.

* * *

**Light metals** such as aluminum and aluminum alloys are increasingly replacing steel, non-ferrous metals, and other structural materials in Germany, according to a report to the Department of Commerce from its Berlin office. Outstanding in this development are aluminum-magnesium, aluminum-magnesium-silicon, aluminum-copper-magnesium and the alloys of aluminum with copper, silicon and manganese. At the present time, airplanes lead in the use of light metals, but the application of these weight-saving materials in the construction of rolling stock, buses, automobiles, shipbuilding, and tank cars and such equipment is increasing steadily.

# *Between Base Metal and Boudoir*

**ANY NUMBER OF SCOVILL SERVICES FOR MANUFACTURERS**

Did you know that Scovill makes containers for the majority of famous cosmetic manufacturers . . . that parts of that clock were Scovill manufactured . . . that Scovill supplies the world with common pins . . . makes snap fasteners . . . ferrules for atomizers . . . a dozen more items pictured above?

Or, for that matter, metal parts for electrical equipment, tire valves, diving helmets, rod, wire, tubing and sheet in brass, bronze or nickel silver . . . together hundreds of thousands of products or parts made from brass, steel, aluminum, copper and other base metals?

The Scovill trademark appears on few items which reach the ultimate consumer. Most often Scovill acts as a contract manufacturer, furnishing metal or metal parts which the buyer finds less practical to make himself.

## *Metal and Metal Parts — in Quantity*

When you need parts forged, turned or stamped . . . or screw machine products from the very smallest up to those from 2 3/8 diameter rod . . . or assemblies of metal parts . . . or plumbers' brass goods . . . or condenser tubes — get the benefit of Scovill's long experience in serving American industry. Its designers, engineers, tremendous variety of high-production machinery — may offer you advantages in cost, time or sales appeal that are seldom available elsewhere. Many leading manufacturers rely on Scovill in this way.

Meanwhile, read the fascinating account of Scovill's enterprise in many industries related to metal. Address 35 Mill Street, Waterbury, Connecticut for a free copy of "Masters of Metal".

SCOVILL Masters of Metal

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# ENGINEERING IN WASHINGTON

McGRAW-HILL WASHINGTON BUREAU, *PAUL WOOTON, CHIEF*

**The Seventy-Sixth Congress.** First Session, worked mainly along two lines: it tried to repair previously enacted New Deal reforms to fit in with a swing of public sentiment toward the right, and it authorized tremendous further expansion of national defense, begun last session in the "billion dollar" Navy program. Capitol Hill was at loggerheads with President Roosevelt most of the time on economic reforms, and accomplished relatively little. But it went along with him almost 100 per cent in his determination to defend this country at all costs, appropriating a peacetime record of over $2,000,000,000 for war tackle. The vast Naval and Military programs will greatly widen the field of opportunity for engineers.

* * *

**Army expansion bill,** to build up the Air Corps to 5,500 airplanes, appropriated $300,000,000, more than $50,000,000 of which has already been awarded. Orders for five new types of light and heavy planes will pour out from now on, for completion of the program by June 30, 1941. For "educational orders" covering a wide range of non-commercial "critical" munitions, $18,250,000 was allocated to the War Department for this year alone. Similar amounts will be appropriated in coming years.

* * *

**Strategic materials** such as aluminum, chromium, antimony, mica, optical glass, rubber, tin will be accumulated under a four-year $100,000,000 authorized program; $10,000,000 was appropriated for 1940.

* * *

**Aviation research,** that much-buffeted additional laboratory for National Advisory Committee for Aeronautics, was finally authorized at a cost of $10,000,000, without designation of the location, but it probably will be California.

* * *

**Critical weapons,** anti-aircraft and anti-tank guns, tanks, gas masks, automatic rifles, artillery, all the latest design, were provided for in a supplementary appropriation of $110,000,000.

* * *

**Arsenal machine tools** to replace obsolete equipment in the six arsenals will be purchased with an appropriation of $6,000,000. This is the first step in a $16,000,000 program.

**Army supply bill** for 1940 gave aviation $74,220,637 for all purposes, including construction of aircraft previously authorized, and $1,000,000 for research. Ordnance got $30,420,000. The Second Deficiency bill included $300,000 for research on rotary wing aircraft.

* * *

**Navy supply bill** for 1940 gave aviation $88,298,000 to continue its building towards a minimum of 3,000 airplanes, and $270,000,000 to continue ship construction, including two 45,000-ton battleships.

* * *

**Merchant marine fleet** is building at the average rate of 50 ships a year under the Maritime Commission, which got a cash appropriation of $100,000,000 plus contract authority of $235,000,000.

* * *

**Airplane cabin insulation** against cold will be accomplished by about the same means employed to insulate houses. Recently, at the request of the National Advisory Committee for Aeronautics, the Bureau of Standards undertook an investigation of thermal insulation of aircraft. Insulation has not been neglected by airplane manufacturers but their attention has been directed mostly against cabin noise. As in houses, light fire-proof materials will be put between double walls. It is desirable that one of the surfaces inclosing the insulation have a bright metal finish, which loses heat less rapidly than dark surfaces. One problem is collection of moisture by the insulating material. Warm moist air from the inside should be excluded, while cold dry air from the outside is allowed to flow slowly through the insulating materials.

* * *

**Designers throughout the world** will welcome a series of steam tables worked out by the Bureau of Standards in cooperation with American Society of Mechanical Engineers. The economy with which steam power is produced is dependent upon a knowledge of the thermal properties of water and steam in the entire reasonable range of temperatures and pressures. Accurate information about the strength of steel is no more important to the bridge builder than correct steam data is to the mechanical engineer. The work just completed covers the properties of water and saturated steam in the range from 32 deg. to 750 deg. F—that is, between freezing and the critical pressure of about 3,200 lb. per sq. in.

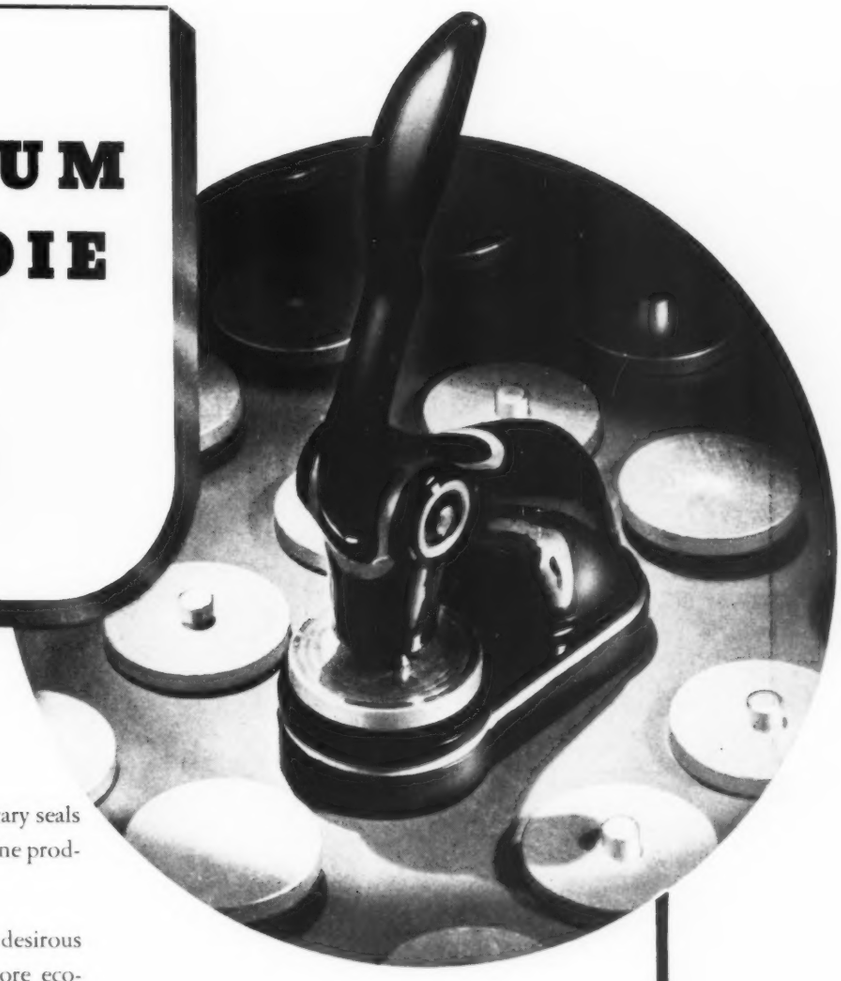
* * *

**The art of ship design** stood still and was partially lost to this country during 20 years of almost complete inactivity. The Navy, with its great research staff, has no qualms whatever about its ability to design new ships equal to any in the world. It reassured doubters by outlining its intensive model experimentation, which was never relaxed. Maritime Commission engineers are nearly all in strange waters, but they, like the Navy, feel that their fresh viewpoint will be an advantage rather than a handicap. A point ambitious designers shouldn't miss is that this country beyond any doubt will lead all others in naval power, and may run the merchant powers a close race.

* * *

**Six patent law changes** were enacted by the session of Congress just closed. The changes, designed to help the manufacturer and the inventor as well as the public, are: (1) Reduction from two years to one year in the time allowed for public use of an invention before applying for a patent. (2) Simplification of the previous interference practice by providing a three-man board of examiners to pass on interference cases. (3) Repeal of the provision for renewal of application where issuance of patent has been ordered but where the fee has not been paid. (4) Provision that no amendment of an application, presenting for the first time a claim which is the same as a claim of an issued patent, may be made unless the amendment is filed within one year from date of issue. Previous time allowed for copying claims was two years. (5) Authorization of the Commissioner of Patents to fix a period shorter than the existing six months between the date of filing and the date that the application must be completed and ready for examination. (6) Reclassification of Patent Office records, an act which will expedite the examination of future patent applications . . . Two major revisions which made progress in Congress this year and which will be taken up at the next session are: (1) Termination of the life of a patent at 17 years after date of issue or 20 years after date of application, whichever is shorter. (2) The setting up of a single court to handle patent litigation . . . Apparently compulsory licensing is in the waste basket.

# AN ALUMINUM STAMP DIE STAMPED O.K.



IN the past, dies of corporations and notary seals were generally made either as screw machine products or hot forgings.

A nationally known seal manufacturer, desirous of obtaining die blanks in quantity, more economically, came to Scovill. As the part required was simple in design and symmetrical in shape, Scovill suggested cold pressings of aluminum, as these permitted substantial savings.

In use, the necessary letters and design are stamped into the aluminum die blank by steel punches, thus forming the female or top die. The male die is produced by pouring a soft metal alloy over the aluminum female die.

For satisfactory die making, the aluminum die blanks must be carefully controlled, both as to hardness and yield strength. Grinell hardness of the part is kept at approximately 110, but any lower hardness down to about 37 could be supplied if required.

This is another example of where a customer effected savings on the production of metal parts, due to Scovill's metal-working knowledge and the extent and variety of its facilities. It might be well to remember that Scovill works in steel, copper, brass, nickel silver, aluminum and other base metals, and is now helping many a leading manufacturer with metal part problems. Scovill may be able to help you, too. — May we try?

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# ENGINEERING IN WASHINGTON

McGRAW-HILL WASHINGTON BUREAU, *PAUL WOOTON, CHIEF*

**Repeal of the arms embargo** now seems certain, barring unforseen events. Best guess is that the act will be signed early in November. Munitions supply to the Allies would begin immediately after signature. Chief item of arms needed is, of course, airplanes. Aircraft orders are already being delivered to the East coast for quick shipment in anticipation of repeal. Bombers will be flown across from Canada. Small planes might also be flown, with several British naval plane carriers stationed along the route. The Allies have some $8,000,000,000 in securities and gold for purchases in this country. When that is gone they will have to ask for credit, because they are loaded to the guards with national debt and taxes. Opinion is expressed privately here that our Johnson law, which forbids further credit to World War debt delinquents, will be modified, or some way found around it, if credit would reasonably assure victory for France and England.

* * *

**High temperature, high pressure** steam is being brought to efficient use in merchant shipping as well as in the Navy. The Maritime Commission, designing its standard C1, C2, and C3 cargo vessels is contributing to this progress. At one time diesel power seemed likely to replace steam entirely in medium and small ships. But high-temperature-pressure steam is now nearing the economic efficiency of diesel for medium and low tonnage.

* * *

**Planes or battleships?** On and on goes the old controversy whether bombing planes can seriously damage or sink battleships. If they can, and if the technique of bombing can be improved as claimed, the military value of floating armament will have to be reconsidered. United States naval authorities are still uncertain whether British and German reports of destruction of naval vessels are true. If they are true, and if successful bombings continue, look for a reshaping of our naval construction policy.

* * *

**U. S. airplanes best?** Nobody really knows what country does produce the best airplanes. It is natural for Americans to think that this country does, and this opinion is being confirmed now by reports from South America, where the German and Italian market is being abandoned in favor of the United States, and from France, which is using some American equipment in the war. If our planes are superior, they will have ample opportunity to prove it through wide distribution among both neutral and (if the embargo is repealed) belligerent nations.

* * *

**Gasogene vehicles,** which use wood gas, are being encouraged in Italy's attempts to reduce consumption of all classes of motor fuel, reports the Commerce Department. Italian Minister of Communications has offered prizes for design of such vehicles and has granted subsidy to 36 firms operating bus lines for conversion of 52 buses.

* * *

**Airplane tow-line device** for picking up air mail at small stations without landing, owned by Richard Du Pont, is getting inquiries from foreign countries and from congressmen and many municipalities in this country. The pickup is proving successful in use by the American Airlines, operating under a Post Office experimental program, in three or four Eastern states. . . . Curbstone experts say that Du Pont is about to finance the manufacture of helicopters in this country. Germany has recently had phenomenal success with these rotary wing machines. A helicopter rises by lift of powered vertical propellers, and moves forward when the propellers are slanted to give component vertical and lateral thrust. The autogiro rises by vertical lift of auto-rotating wings when the machine is moved laterally by a conventional propeller.

* * *

**A metal substitute for gold** and platinum is claimed by Japan, the American Commercial attache reports. The new metal, which is called "novoplatino" is reported to be an ideal alloy, easily rolled, has elasticity. It is light in weight, but has a hardness equal to 22 karat gold and is suitable for usual commercial manufacture. Its producers describe it as having "beautiful color and everlasting luster." It is being offered at the equivalent of 44 cents per 3.75 grams.

* * *

**An "idea creating plant"** was proposed by Acting Secretary of the Navy Charles Edison in his third press conference since taking office at the Naval Research Laboratory at Bellevue, D. C. He said most of the Navy's $20,000,000 experimental fund now goes to improvement of existing designs. Too much attention is given to "spring styles" in what we already have, he said. He wants new departures in design. To carry out his plan, Edison transferred the Laboratory from the Bureau of Engineering to independent status under his personal direction. He gives credit for his idea to his illustrious father.

* * *

**Silver is used sparingly** in essential articles in Germany but is increasingly used there for industrial purposes, the American Consulate General reports to Department of Commerce. Hard-solder alloys, incorporating silver, copper, and zinc, have found application in electrical apparatus, chemical and food processing equipment, oil conduits for airplanes and motor vehicles, and in alloys for linings of primary bushings and bearings under heavy load and high speed in airplane engines.

* * *

**Testing new types of magnet** material requires higher magnetizing forces than are used in testing older type materials. R. L. Sanford and E. G. Bennett, of the Bureau of Standards have developed a new permeameter, capable of testing forces up to 5,000 oersteds, which is ample for the hardest metals in use.

* * *

**Somite,** an acetyl cellulose plastic claimed to be an ideal substitute for metallic materials, will be manufactured commercially in Japan, according to American attaches at Tokio, as reported by the Department of Commerce. Made of waste fiber by the viscose process, Somite has the plasticity of synthetic resin, ductility of celluloid, and the strength of vulcanized fiber, the report says. It is being used in conduit tubes, hinges, door handles, radio sets, lighting apparatus, and many other products; is said to be insoluble at high temperatures and resistant to acid attack.

* * *

**Administrative regulations** have just been issued to the German automotive industry, greatly reducing the number of types of parts and accessories the industry may manufacture, according to a report of Paul H. Pearson, Assistant American Trade Commissioner, made public by the Department of Commerce.

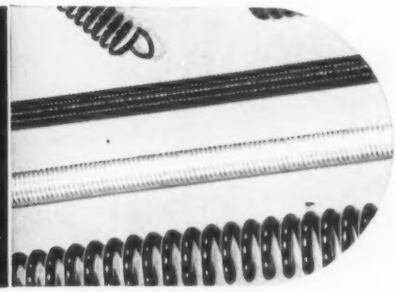
## . . . DON'T LET PROGRESS PASS YOU BY!

THE best steel springs you could buy last year may be only second best today. Spring designs, as well as developments in steel, change rapidly. A careful check of the springs you are using may result in greatly improving the efficiency and increasing the saleability of your product.

We suggest that you take advantage of the wide range of experience and expert assistance our engineers, designers and metallurgists have to offer. These men are daily working out problems involving springs of the most unique and complex design. The valuable assistance which these men have given is one important reason why you will find American Quality Springs serving faithfully in all of the country's largest industries.

Bring your spring problem to us. Let us design the spring that best suits your product, and supply you with American Quality Springs that will give lasting service and economy.

AMERICAN *Quality* SPRINGS



**AMERICAN STEEL & WIRE COMPANY**

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

# CLASSIFIED INDEX *of* 1939 DEVELOPMENTS

**AS PRESENTED IN THE SURVEY SECTION**

*Asterisks indicate examples of applications*

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Ten manufacturers of articles which might be found in Santa's bag . . . use Scovill's metals and Scovill's engineering and manufacturing facilities to put into physical form their ideas for winning new markets or lowering costs.

Some of them needed metal parts made better, or faster, or more economically, than they could do it themselves; and for these Scovill takes care of *complete* production and assembly. Others purchased Scovill brass, bronze, or nickel silver in the form of sheet, rod, wire or tubing — and from this material fabricated within their own organization the products which they market.

## METAL AND METAL PARTS . . in Quantity

Thousands of other manufacturers—of bicycles, cosmetics, underwear, electrical equipment —give Scovill the job of supplying the metal ingredients for their products . . . base metal or quantity-ordered parts forged, turned or stamped from brass, steel, aluminum, copper, etc. . . . screw machine products . . . drawn shells . . . small fabricated parts. On plumbers' brass goods, condenser tubes, containers and closures.

To those of you who have not before realized the great extent of Scovill's service to industry—we suggest investigating how Scovill's designers, engineers and production equipment can be put to work on *your* ideas in metal. As a starter, why don't you read through "Masters of Metal"? Write 35 Mill Street, Waterbury, Connecticut for a free copy.

SCOVILL
*Masters of Metal*

**SCOVILL MANUFACTURING COMPANY**
WATERBURY, CONNECTICUT

Boston, Providence, New York, Philadelphia, Syracuse, Pittsburgh, Detroit, Chicago, Cincinnati, San Francisco, Los Angeles. IN CANADA: 334 King Street, East, Toronto, Ontario

PRODUCED BY AN ORGANIZATION MAKING STAINLESS STEELS EXCLUSIVELY

## 2 YEARS OF MACHINING RESEARCH CONDENSED ON THIS CHART FOR YOU

Your questions as to speeds, feeds and cuts in machining stainless steels are instantly answered by this machinability chart—sent on request if you write on your company letterhead.

This chart incorporates the boiled-down results of two years of intensive research, during which a full-time force of metallurgists and machinists cut, formed, drilled, and tapped thousands of specimens, under controlled and recorded conditions, and with varied types and designs of tools. It helps you to cash in on the added potential in production and profits that Rustless specialization puts into Rustless Stainless Steels. May we send you one?

**RUSTLESS IRON AND STEEL CORPORATION · BALTIMORE · MD.**

*Producing Stainless Steels Exclusively*

RUSTLESS
STAINLESS STEEL
BARS AND WIRE

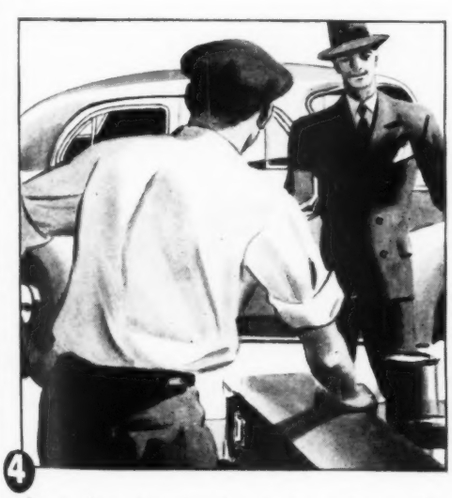
SALES OFFICES: **CHICAGO**—4201 IRVING PARK ROAD · **CLEVELAND**—731 SOCIETY FOR SAVINGS BUILDING · **DETROIT**—4-137 GENERAL MOTORS BUILDING · **PHILADELPHIA**—1263 COMMERCIAL TRUST BUILDING · **DISTRIBUTORS IN PRINCIPAL CITIES**

# 'I THOUGHT THEY WERE PASSING THE BUCK!'

**1** **Was I burned up** when the air pressure failed again! "You couldn't pay me to keep a machine like that new compressor!" I yelled.

**2** **I called** the Tornado Compressor Company*: "Your new compressor wouldn't pump up a bicycle tire," says I. "It sounds funny and won't come up to pressure. What can you do about it?"

**3** **"So they claim** something is wrong with the motor!" I fumed. "Sounds to me like passing the buck. What I want is air pressure — not excuses!"



**4** **In a few hours,** though, in walks a G-E engineer. "The Tornado Company tells us you're having trouble with a G-E motor," he says. "Let's have a look at it."

**5** **I hadn't realized** how low the voltage was until he showed me his tests. We were trying to run the compressor on an already overloaded lighting circuit. Nothing was really wrong with the compressor unit.

**6** **It runs like a song** with new wiring. Now I'm glad to tell anyone: "You can't beat a Tornado Compressor, especially when it's equipped with a G-E motor."

THIS true account is typical of the way G-E service builds good will for machinery manufacturers whose machines are G-E equipped.

No matter where your customers are located, they can always get quick service from our sales engineers in 103 cities, our 28 warehouses, and our 25 service shops. Charges for such service calls are extremely reasonable.

Are you *now* in need of any information on electric equipment? Perhaps a discussion of your requirements with our engineers might help you iron out an electrical design problem. Just call our nearest office or write to General Electric, Schenectady, New York.

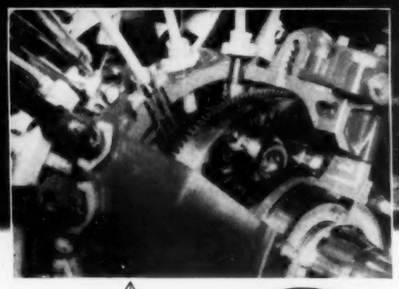
*TORNADO *is not the manufacturer's real name, of course.*

NEW YORK WORLD'S FAIR—SEE THE G-E "HOUSE OF MAGIC"—SAN FRANCISCO EXPOSITION

**GENERAL ELECTRIC**

011-539

# WRIGHT CYCLONES
## Use Planetary-gear System for Dependability and Compactness



Planetary-gear system used in Wright Cyclone aircraft engines

Planetary-gear system used in General Electric gear-motors

Typical G-E gear-motor

## *You Get* the Same Advantages in G-E Gear-Motors

LIGHT WEIGHT, compactness, simplicity are extremely important in all phases of aircraft engine design. The Wright Aeronautical Corporation has solved the problem of obtaining the desirable light weight, compactness and efficiency in the reduction gearing of Cyclone propeller shafts by using a planetary gear system.

By using G-E gear-motors for low-speed drives, industry, too, can obtain the very desirable feature of compactness, with that high degree of reliability so essential in modern airplane drive, since G-E gear-motors use the same type of planetary system in their gear-reduction units as is used in the propeller drives of modern airplane engines.

No matter what type of low-speed drive you may need for your conveyors, pumps, mixers, or other low-speed machines, a G-E gear-motor is the correct solution. General Electric gear-motors are available in ratings from $\frac{1}{8}$ to 75 hp, with output speeds from 6 to 600 rpm, in polyphase, single-phase, or direct-current types—a type of modification to fill every low-speed drive purpose.

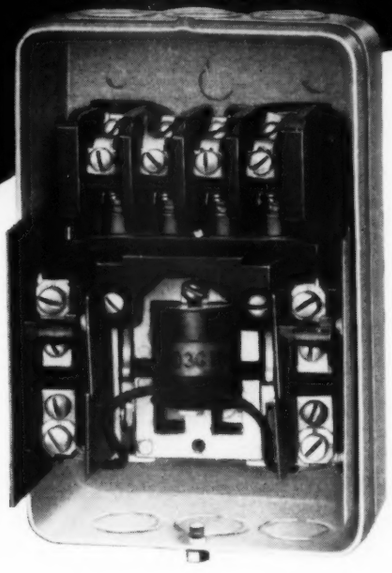
Investigate the many advantages obtainable by the use of G-E gear-motors for your low-speed drives. For further information, call the nearest G-E office or write General Electric, Schenectady, New York.

**GENERAL ELECTRIC**

020-389

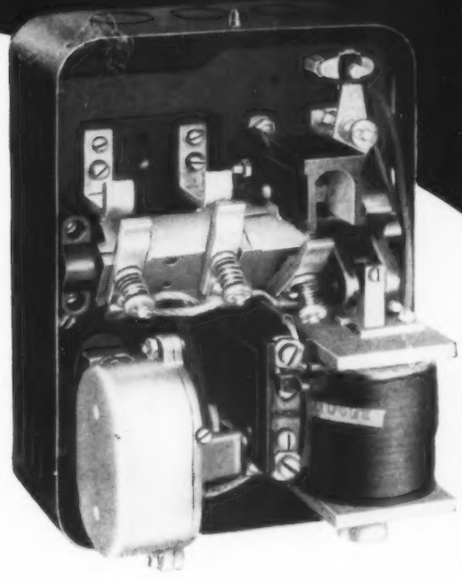
# Here's What's New in MAGNETIC STARTERS

**FOR A-C MOTORS:**
**CR7006-D50**



New isothermic overload relay used on both starters adjustable for either manual or automatic reset.

**FOR D-C MOTORS:**
**CR4052**



Push-button or selector switch can be obtained in cover of new a-c starter, making it a complete, self-contained control.

SMALLER than any other starter we've ever offered, this new Size O is ideally suited for controlling motors rated up to two horsepower. Its compactness saves space on built-in control systems. Actually, it is little larger than a manual starter, yet it provides the advantages of remote, push-button operation, isothermic overload protection, and undervoltage protection—just as do starters three times its size. Fine-silver to fine-silver contacts, and a new type of operating magnet with built-in pole shaders and air gap assure a designer that the machine he equips with the new Size O starter will stand up electrically. Price of the new starter, for 3-phase motors, is $14.00.

A NEW design from line connections to load terminals, this starter provides three-point sequence starting for d-c motors. A mechanical time-delay mechanism, in constant engagement with the operating shaft, prevents chance of false operation during starting. For the first time in a d-c starter, isothermic overload protection is provided.

*General Electric, Dept. 6C-201,*
*Schenectady, N. Y.*

*Please send me your latest information on:*

- ☐ *New Size O a-c starter*
- ☐ *New CR4052 d-c starter*

*Name* .....

*Firm* .....

*Address* .....

080-177

**GENERAL ELECTRIC**

# LOW-MAINTENANCE FHP MOTORS

# FOR HEAVY-DUTY SERVICE

- DAIRY EQUIPMENT
- DRY-CLEANING EQUIPMENT
- GREASE GUNS
- LIFTS AND HOISTS
- MACHINE TOOLS
- METALWORKING MACHINES
- PUMPS AND COMPRESSORS
- SHOE MACHINERY
- TEXTILE MACHINERY
- WOODWORKING MACHINERY
- LAUNDRY EQUIPMENT

WHETHER for start-and-stop service on lifts and hoists or for continuous duty on pumps and compressors, General Electric fractional-horsepower motors will operate your machines long and dependably with little or no attention. Their construction embodies years of experience in building motors to meet the load demands and conditions encountered in applications like those listed above. Large overload capacity is provided for peak loads. Bearings are large and require only occasional oiling. The latest type of insulation — resistant to moisture, oil, and mild acids and alkalis — is used.

Standard G-E motors with the proper electrical characteristics and mechanical features are available for *your machines* — motors with high or low starting torque; motors that are dripproof, explosion-proof, or totally enclosed; motors for solid, resilient, flange, or vertical mounting; to mention but a few. Speed ratings range from 3450-rpm, two-pole motors to 5.7-rpm gear-motors. For additional information on G-E motors, contact the nearest G-E sales office or write to General Electric, Schenectady, N. Y.

**SEE THE G-E "HOUSE OF MAGIC" AT BOTH FAIRS**

## ANY TYPE YOU NEED

**SPLIT-PHASE MOTORS**
Moderate starting torque
Single-phase

**CAPACITOR-MOTORS**
High starting torque
Single-phase

**GEAR-MOTORS**
Single-phase, polyphase, or direct-current

**POLYPHASE MOTORS**
Same mounting dimensions and characteristics as other G-E Motors

**DIRECT-CURRENT MOTORS**
Interchangeable with a-c motors

# GENERAL ELECTRIC

070-280

# OF A NEW FASTENING METHOD THAT CUTS ASSEMBLY COSTS AN AVERAGE OF 50%

Let's get inside the recess of a Phillips Screw and find out how thousands of manufacturers save money by using Phillips Screws.

- **QUICKER ASSEMBLY**
  Note the many surfaces where driver contacts recess. More driving power results — an easier, quicker job.
- **NO BURRS TO REMOVE**
  Observe the *flat* surfaces. No curves except at the rim. That — together with the close fit — prevents burrs.
- **NO SPLIT HEADS**
  It took thousands of experiments to determine the angle of taper utilizing maximum turning power without sacrificing strength.
- **REFINISHING COSTS SAVED**
  The recess keeps the driver from slipping. This saves accidents and refinishing costs. Faster driving is perfectly safe.
- **PERFECT BALANCE — DRIVER AND SCREW SIZES**
  The driver should fill the recess to the outer edge — otherwise, turning action is limited by driver size. Or, if the driver is too large, you're apt to strip the fibre structure of wood or metal. That's why we have four sizes Phillips Drivers to cover all screw sizes (half as many as for slotted screws). Two drivers handle sizes #5 to #16 (85% of all screws).

Try Phillips Screws in your plant. See how they cling to driver . . . drive straight automatically . . . drive home with much less effort . . . provide much stronger assembly.

# PHILLIPS RECESSED HEAD SCREWS

MACHINE SCREWS · SHEET METAL SCREWS · WOOD SCREWS · STOVE BOLTS

*This booklet will help your plant cut fastening costs and improve assemblies.*

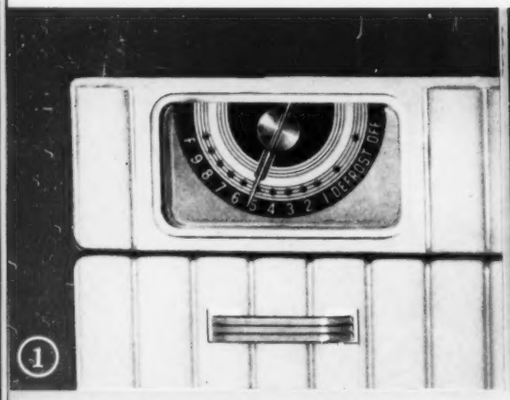
Address one of the firms below for free copy.

U. S. Patents on Product and Methods Nos. 2,046,343; 2,046,837; 2,046,839; 2,046,840; 2,082,085; 2,084,078; 2,084,079; 2,090,338. Other Domestic and Foreign Patents Allowed and Pending.

American Screw Co., Licensor, Providence, R. I.
Chandler Products Company, Euclid, Ohio
Continental Screw Co., New Bedford, Mass.
Corbin Screw Corporation, New Britain, Conn.
The Lamson & Sessions Co., Cleveland, Ohio
National Screw & Mfg. Co., Cleveland, Ohio
Parker-Kalon Corporation, New York, N. Y.
Pheoll Manufacturing Company, Chicago, Illinois
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterbury Conn.
Shakeproof Lock Washer Co., Chicago, Ill.

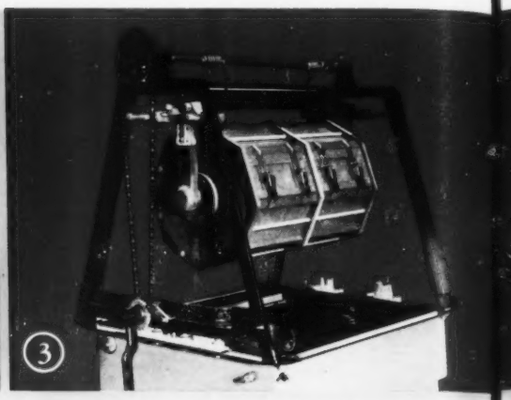
IT COSTS LESS TO USE PHILLIPS SCREWS

# 9 Reasons why "Vinylite" Plastic

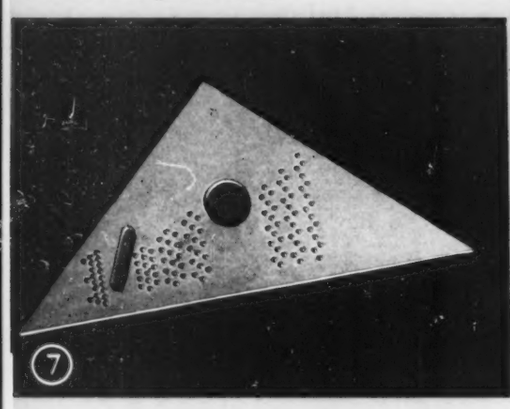



① *Philco uses* "Vinylite" plastic sheets for the dial on the new Conservador refrigerator because they won't warp from water or moisture absorption. Tests show that these sheets absorb only 0.05 per cent water during immersion for 24 hr. as compared with 1.5 per cent for other plastic sheets.

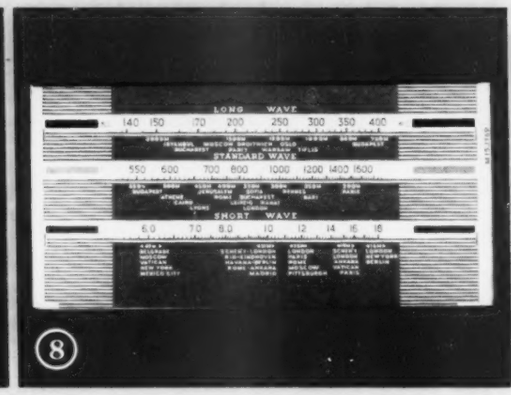
② *Pan American Airways uses* "Vinylite" plastic sheets for wainscoting in the dressing rooms of their new Clipper ships because they are light in weight, won't warp or shrink, and are non-flammable. They have a colorful and decorative value, are stainproof and easy to clean.



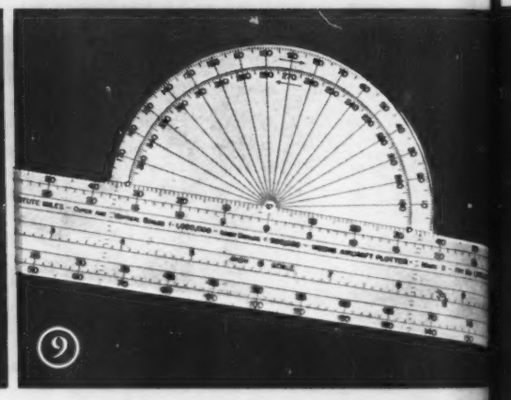
③ *Formica uses* "Vinylite" plastic sheets for nickel plating barrels because they are chemically inert . . . are not affected by nickel plating solutions. In addition, they are strong and tough and resist the abrasive wear which is involved while holding and rotating the parts being plated.



⑦ *Drafting Triangles are made of* "Vinylite" plastic sheets because they do not warp or shrink on aging . . . remain accurate for years. Furthermore, no seasoning period is required before putting them in use, which saves in inventory costs and seasoning equipment.




⑧ *Translucent Panels are made of* "Vinylite" plastic sheets for many purposes because they can be printed on in multiple colors with perfect register even when long periods intervene between press runs. They do not shrink or warp during printing or use. They are non-flammable.



⑨ *Calculating Instruments are made of* "Vinylite" plastic sheets because they stay accurate . . . won't curl or shrink out of shape or size. Water and moisture do not affect them. In such instruments, even the slightest inaccuracy can result in large and serious errors.

THESE few illustrations may suggest how you, too, can use "Vinylite" resin sheets profitably. Study the unusual properties at the right and start now to put them to use in your product . . . to improve quality . . . to enhance appearance . . . to increase sales appeal.

"Vinylite" resin sheets are available in a range of thicknesses and a variety of exquisite shades and colors. They can be transparent, translucent, or opaque, and can be calendered, matte, or polished finish. Send for a book of samples and let us help you with any application you have in mind, without obligation.

*Plastics Division*
CARBIDE AND CARBON CHEMICALS CORPORATION
*Unit of Union Carbide and Carbon Corporation*
30 East 42nd Street UCC New York, N. Y.
PRODUCERS OF SYNTHETIC ORGANIC CHEMICALS

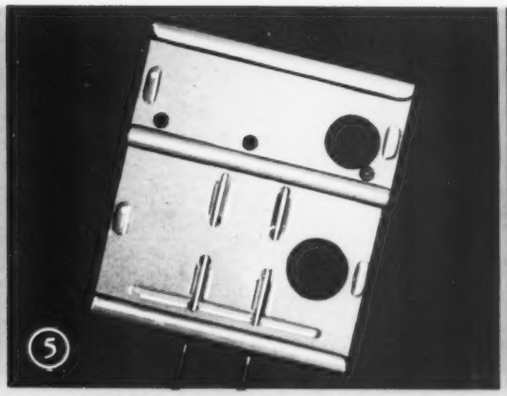
# Vinylite Resins *plastics for*

TRADE MARK

# Sheets *improve these 9 Products*

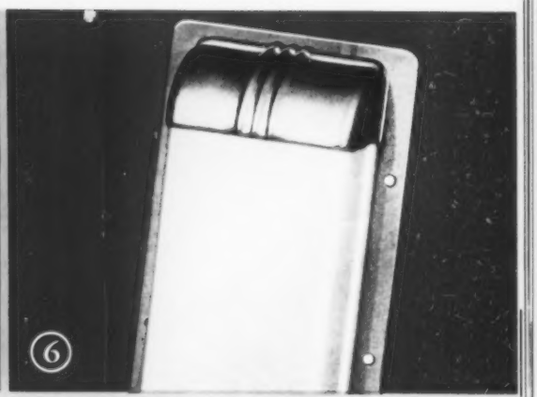
④

*Hoover uses* transparent "Vinylite" sheets for the window on the new Hoover electric cleaner because they don't break easily, won't soften under the heat of the lamp, are inexpensive, and are non-flammable . . . won't even support combustion. In addition, they are easy to fabricate and will not shrink and loosen.



⑤

*Meat Price Tag Holders are made of* "Vinylite" plastic sheets because they won't impart any odor, taste, or toxicity to the meats. Besides, they won't warp or discolor and will maintain their shape over the wide range of temperatures and humidities encountered.



⑥

*Crystals are made of* "Vinylite" plastic sheets for radios, clocks, and other instruments because they can be easily deep-drawn and retain their formed shape. In addition, they won't warp or shrink and are non-flammable, which helps assure Underwriters' Laboratories, Inc. listing.

*Send for Samples* A request on your company letterhead will bring you, without obligation, samples of "Vinylite" resin sheets, in convenient book form. This will permit you to see and feel these unique plastic sheets in their standard colors and finishes, and will facilitate ordering by number. Every designer, fabricator, laminator, and user of plastics should have these samples. Send for yours *now*.

## *Only "Vinylite" Resin Sheets Have All These Properties*

1. They do not curl, blush, or get sticky—water and moisture do not affect them.
2. They are non-flammable and will not support combustion.
3. They are completely resistant to oil, grease, and alcohol, and highly resistant to practically all chemicals.
4. They are exceptionally strong, tough, and rigid even at below-freezing temperatures.
5. They are tasteless, odorless, and non-toxic.
6. They can be easily formed, drawn, and laminated under heat.
7. They do not warp or shrink on aging—no "seasoning" period is necessary.
8. They can be printed on in multiple colors with perfect register.
9. They have and maintain uniform properties in all thicknesses.

Sheets available in quantity, in a variety of colors, thicknesses, and finishes.

The word "Vinylite" is a registered trade-mark of Carbide and Carbon Chemicals Corporation.

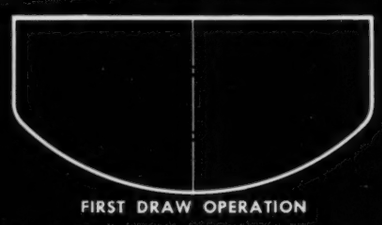
*for many purposes*

SHEETS FILM TUBES RODS EXTRUDED SHAPES ADHESIVES

# *Aluminum*

## • HAS •

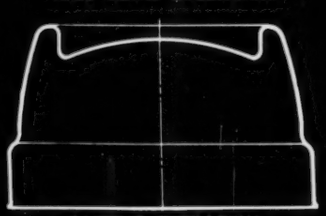
## SUPERIOR WORKABILITY



FIRST DRAW OPERATION

SECOND DRAW OPERATION

FINAL DRAW OPERATION



CAPPING OPERATION

Aluminum is formed like any other metal. Standard equipment and the usual skilled labor are employed. Its excellent working properties, however, contribute greatly to the economic production of finer products.

Metal workers will be interested in the steps by which Alcoa Aluminum beer barrels are formed in regular production-line manufacture. Three progressive draws and a fourth capping operation completely shape a beer barrel half, ready for assembly by the welder.

Dies and depth of draft, of course, take into account the individual characteristics of the alloy being used. That's part of the "know-how" gained by Alcoa engineers in years of dealing with the fabrication of Alcoa Aluminum Alloys. This information is available to you. ALUMINUM COMPANY OF AMERICA, 2193 Gulf Bldg., Pittsburgh, Pa.

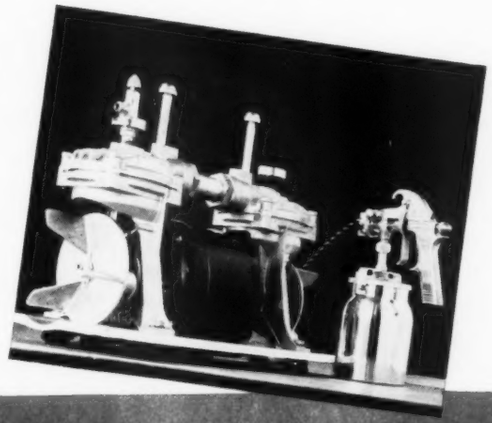
ALCOA ALUMINUM

# *Aluminum* BECAUSE OF ITS LIGHT WEIGHT AND DURABILITY

Binks Manufacturing Company of Chicago wanted to produce an air compressor for paint spray work, which could be carried about easily. It had to be sturdy enough to withstand hard usage. They say, "Naturally, we turned to Aluminum."

The resulting unit, shown below without its streamlined cover, weighs only 44 pounds. It is carried like a small suitcase. The Alcoa Aluminum die castings pictured here are important contributors to its light weight and compact sturdiness.

The die casting process gives an accuracy of dimensions and a fineness of surface and details which greatly reduce fabricating time and costs. Have you investigated the use of Alcoa Aluminum die castings as a means of improving your product and cutting costs? Our engineers will gladly help you make such a study. ALUMINUM COMPANY OF AMERICA, 2193 Gulf Building, Pittsburgh, Pennsylvania.



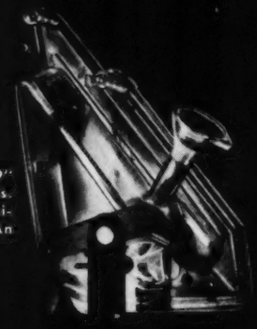
ALCOA ALUMINUM

# *These ten awards lead the way to...*

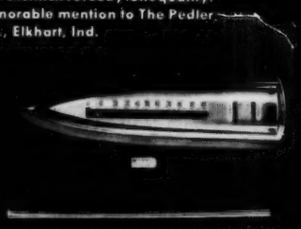
## NEW USES FOR PLASTICS—NEW BEAUTY FOR PRODUCTS

**IN CLEANLINESS**—This transparent "Lucite" brush back makes it hard for dirt to hide. Can be scrubbed without harm. The "Exton" bristles are made from Du Pont nylon. A top award to Hughes-Autograf Brush Co., New York City.

**IN MUSIC**—Something different! The Paul Whiteman and Phil Spitalny orchestras use this unique clarinet of "Lucite." It's transparent. Distinctive reedy tone quality. Honorable mention to The Pedler Co., Elkhart, Ind.



**IN CHEMISTRY**—right—For combustion engineers, this 5½"x9" automatic Orsat gas analyzer makes an analysis in 30 seconds. Visible process, too! Molded of "Lucite" for Hays Corp., Michigan City, Ind., by Modern Plastics, Inc., Benton Harbor, Mich. An honorable mention.



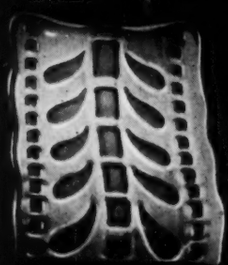
**FOR THE AUTO**—A "Lucite" lens magnifies the small figures of this odometer to twice size... trip mileage is easily read night or day. "Lucite" also for transparent dash panel crystals. Honorable mention to Hudson Motor Car Co., Detroit, and to Norton Laboratories, Lockport, N. Y., the molders.

**IN AMUSEMENT**—Unique beauty in a roulette wheel of "Lucite." Some parts crystal clear. Others in soft translucent colors. A top award to E. M. O'Neil & Co., Chicago, Illinois, and to the fabricators, Keolyn Plastics Corp., Chicago, Ill.

**FOR DECORATION**—"... the striking beauty of crystal clear "Lucite" adapted to a product worthy of modern home decoration," was Don Manning's plan for this centerpiece. Top award to Don Manning & Co., Rochester, N.Y.

**IN DENTISTRY**—Combination of pink and crystal-clear "Lucitone" denture material allows natural flesh color of mouth roof to show thru for better appearance. Top award to L. D. Caulk Co., Milford, Del.

**FOR THE AUTO**—A "Lucite" clock crystal that's safer, smarter. It helped Nash Motors of Kenosha, Wis., win a top award. Boonton Molding Co. of Boonton, N. J., did the molding.



**FOR ARCHITECTURE**—Leaf design similar to that of the all "Lucite" ceiling in the Cocktail Lounge in the St. Francis Hotel, San Francisco. Unusual light-diffusing qualities. Top award for Timothy Pfleuger, Designer, and Dave Swedlow, Hollywood fabricator.

**FOR DISPLAYS**—The *plastic* pup with his slightly underfed look creates attention for store windows. Fashioned of "Lucite," he took a top award for Crystal Fixture Co., of Chicago.

## *Find new profits with Du Pont Plastics!*

A WHOLE GROUP of honors for Du Pont plastics . . . That's the story from the Modern Plastics Competition. Dramatic "Lucite" is a *natural*. And you'll find *all* Du Pont plastics have winning applications.

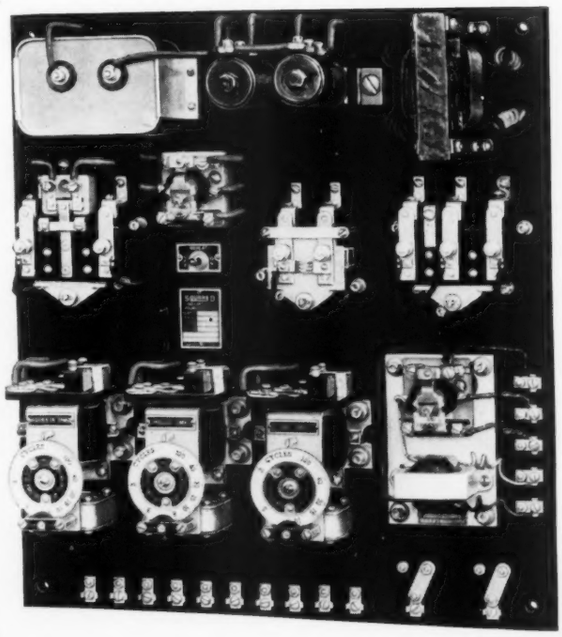
To your thrill of winning we add our congratulations . . . to designers, molders and manufacturers. The sweeping product improvements and vast markets opened by new products are great contributions to America. Du Pont is proud to share in this work.

Du Pont plastics include "Lucite" methyl methacrylate resin, "Pyralin" cellulose nitrate, "Plastacele" cellulose acetate, "Butacite" polyvinyl acetal. They're all winners . . . for uniformity and high performance . . . for versatility and profit making.

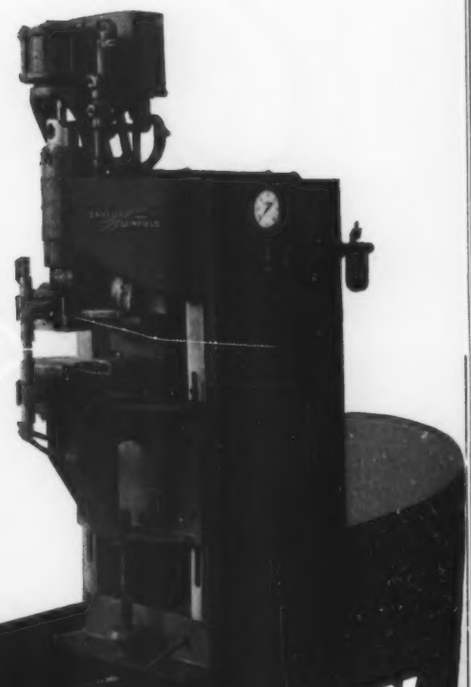
Something else we have for you is a winning set-up in research and engineering to help solve your problems. Next time you have a problem write to Du Pont, Plastics Dept., Arlington, N. J.

DU PONT

**PLASTICS**



CLASS 9052-TYPE BS-6A SEQUENCE PANEL



# *New* . . . .

# SQUARE D SEQUENCE WELDER CONTROL POSITIVELY INTERLOCKS AIR PRESSURE with CURRENT FLOW!

For the automatic functioning of an air-operated welding machine, positive sequence interlocking between the solenoid air valve and the current control is essential.

Whether contactors or electronic equipment are used, the weld timing circuit must be closed and opened while pressure is exerted on the electrodes. Accidental opening of the electrodes, while the current is flowing, must be avoided.

The Square D sequence panel automatically performs the following duties:

1. Controls the solenoid air valve to automatically apply pressure to the work.
2. After a predetermined interval to allow the pressure to build up, it energizes the timer of the current control.
3. When the weld is completed, it determines the period during which the electrodes maintain pressure after the current is cut off.
4. It controls the period when the electrodes are open before the operating cycle is repeated.

For electronic equipment, a protective relay is necessary. This relay is energized from the load side of the power tubes and is specially designed to operate under a wide variation in voltage. This interlocking system prevents the electrodes from opening while any current passes through the electrodes. It also permits independent adjustment of the weld time without changing the other sequence intervals.

*Squeeze time, hold time,* and *off time,* are separately adjustable to suit the exact requirements of the welding operation. Faster production and better welds result.

The Square D sequence panel can be added to the control of any air-operated welding machine to give full automatic operation.

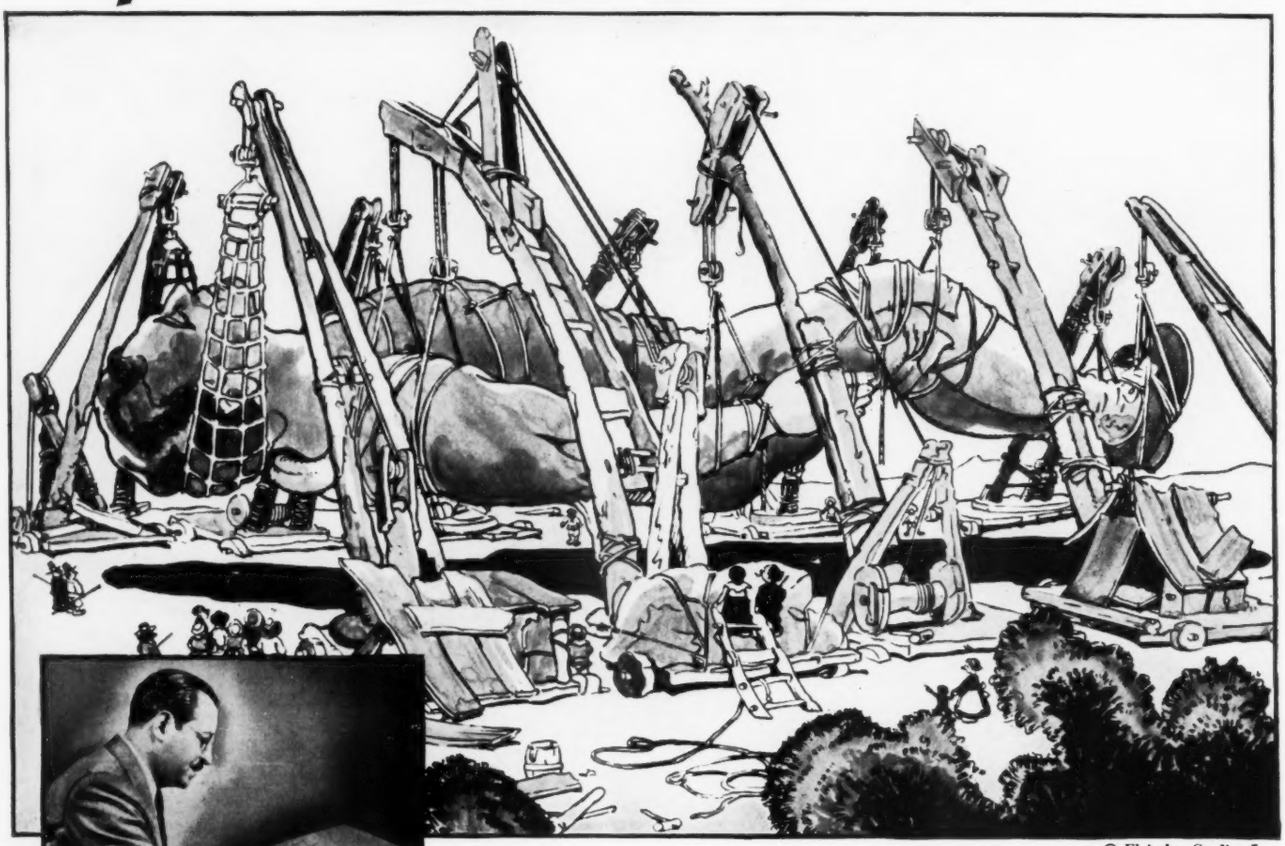
**CALL IN A SQUARE D MAN**

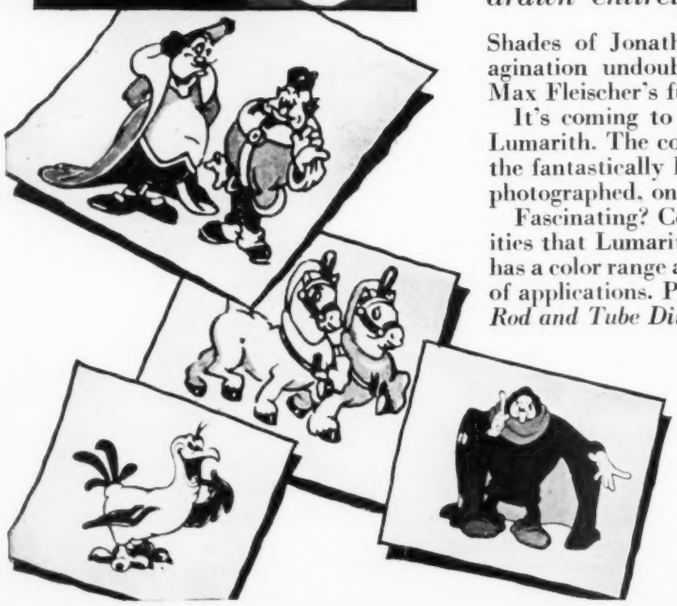
**SQUARE D COMPANY**

DETROIT - MILWAUKEE - LOS ANGELES

IN CANADA: SQUARE D COMPANY CANADA LIMITED, TORONTO, ONTARIO

# *Gulliver* travels on LUMARITH





© *Fleischer Studios Inc.*

## It's a Paramount Picture..

*drawn entirely on Lumarith, the new era plastic*

Shades of Jonathan Swift! Vivid as the venerable Dean's imagination undoubtedly was, he would still be flabbergasted by Max Fleischer's full-length cartoon comedy, "Gulliver's Travels."

It's coming to your local theater soon and it's all done with Lumarith. The colorful characters, the three-dimensional effect of the fantastically beautiful backgrounds . . . all were drawn, then photographed, on transparent Lumarith sheets.

Fascinating? Certainly. But it's only an example of the possibilities that Lumarith presents. In sheets, rods, and tubes, Lumarith has a color range as wide as the spectrum—and an even wider range of applications. Production processes are innumerable. Our *Sheet, Rod and Tube Division* is set up to give you expert service in all stock forms of Lumarith. CELLULOID CORPORATION, 10 E. 40th Street, New York City. Established 1872. Sole Producer of Celluloid and Lumarith. (Trademarks Reg. U. S. Pat. Off.)

*When you think of Plastics, think of headquarters — "The granddaddy of them all" . . . and . . .*

Get in touch with CELLULOID

also Headquarters for Transparent PACKAGING MATERIALS and Molding Powders

# ALLIS-CHALMERS COOPERATIVE ENGINEERING

# HELPS YOU INCREASE YOUR SALES!

**Add the Tremendous Engineering Resources of Allis-Chalmers to Your Own Engineering Department . . . Get a Better Product . . . Lower Your Sales Cost!**

IN PUTTING ALLIS-CHALMERS 10 HP FAN-COOLED Lo-Maintenance Motors and Texrope Drives on their machines, the manufacturers of these modern lathes had the full support of Allis-Chalmers cooperative engineering — a big aid to giving the machines more sales appeal!

It's easier — and more profitable — to sell your machines if they are equipped with Allis-Chalmers Lo-Maintenance Motors!

And here's why —

Through sensational performance in the field . . . through widespread, aggressive advertising . . . and because each installation has the backing of Allis-Chalmers engineering experience and resources — that's why Allis-Chalmers Lo-Maintenance Motors are known to *your customers* as equipment that saves them money!

That's important — especially since it means that you give your customers what they want . . . helps you build sales appeal into your machines . . . cuts your sales cost!

For when you equip a machine with a Lo-Maintenance Motor, you are using a motor that upholds your reputation as a builder of outstanding equipment . . . a motor that delivers more than just a rated horsepower!

That means such modern, extra-value, full-measure features of construction as — high carbon steel frame . . . indestructible rotor . . . distortionless stator . . . no skimping anywhere on materials or workmanship!

Do as hundreds of other original equipment manufacturers are doing — let Allis-Chalmers with 90 years of engineering achievement behind it help you with your motor design problems. Get the whole story on Lo-Maintenance Motors today . . . call the nearest district office, or write direct to Allis-Chalmers.

A1134

. . . 90 Years of Engineering Superiority Work for You When You Specify Allis-Chalmers!

ELECTRICAL DIVISION
ALLIS-CHALMERS
MILWAUKEE · WISCONSIN

# Beetle's IVORY
## Makes a Sales Hit in Shavers

## "More Retailers Specify Ivory Than Any Other Color

*for electric shavers,"* says Mr. H. C. Collins, buyer for Schieffelin & Co., one of New York's leading manufacturers and wholesalers of drug supplies.

More and more manufacturers of products that require housings are using Beetle* because it meets all the technical requirements and provides *COLOR* that gives the extra sales push needed for success. This is confirmed by reports from other manufacturers, wholesalers and retailers throughout the country. The reason is easy to find. Many of the leading fast selling products on the market today are of Beetle, which presents a colorful, permanently neat, lustrous and sanitary appearance — a rich looking, quality effect that appeals to the sense of sight and the sense of touch. Among the many well known electric razors using Beetle ivory are those shown above — the Remington Close-Shaver, the Gemlectric, and the Rand Shaver. If you have a product, a housing, or a package that needs sales-building *color* — any color — a combination of colors — let Beetle's staff help you make a selection that will increase your sales.

**BEETLE PRODUCTS DIVISION OF AMERICAN CYANAMID COMPANY**
32 ROCKEFELLER PLAZA, NEW YORK, N. Y.
*Trade-Mark of American Cyanamid Company applied to urea products manufactured by it.

# Beetle
**IT'S ALL COLOR AND IN ALL COLORS**

There are two kinds of news—the news of today and the news of tomorrow. Veeder-Root Counting Devices write both.

Throughout industry, the news of the day—the production bulletins—are reported promptly and accurately by Veeder-Root Counters mounted on presses, cutters, looms and hundreds of other machines—counters that record operations or pieces produced.

While on the other hand, Veeder-Root engineers, working with manufacturers, are constantly finding important applications for counting and computing devices. These applications make the news of tomorrow—good news to salesmen, because a built-in Veeder-Root Counting Device often increases the utility and sales of a product.

Keep up with the news of Veeder-Root Counting Devices. Send for our booklet that gives a complete picture of their interesting possibilities.

# VEEDER-ROOT Inc.

**HARTFORD, CONNECTICUT, U. S. A.**

**OFFICES IN** Boston, Chicago, Cincinnati, Cleveland, Detroit, Greenville, S. C., Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Montreal, Buenos Aires, Mexico City, London, Paris, Tokio, Shanghai, Melbourne

**IN ENGLAND:** Veeder-Root Ltd., Croydon, Surrey

**IN CANADA:** Veeder-Root of Canada, Ltd., Montreal

# REVOLUTIONARY MERCURY SWITCH DEVELOPMENT

At left, actual size of the largest Durakool Mercury Switch developed to date—without insulating cover. Rated at 200 amperes. Other Durakool Switches from 1 ampere up.

**Check these features of the New Double Reduction Durakool**

- 3-year guarantee
- Cannot pit, burn or corrode
- Simplifies control operation
- Saves money
- Gives complete safety
- Small, compact
- Permanent calibration
- Short-radius action
- Versatile

# DURAKOOL

TRADEMARK REG. U. S. PAT. OFF.

## MERCURY SWITCHES

# "Double reduction" for heavy duty. Removes last obstacle to application of hermetically sealed contacts to higher current ranges. Permits unheard of 3-year performance guarantee. Of outstanding interest to every machine designer and electrical engineer.

MANY machine designers and electrical engineers know the pioneering mercury switch developments by Durakool engineers. The Durakool metal-cased liquid "fill" mercury switch removed many of the limitations on this type of device. For the first time, heavier capacities were possible, and the useful range of the mercury switch extended immeasurably.

*Now, Durakool announces still another important advance, the introduction of a gas fill, under high pressure, to the standard liquid fill Durakool Mercury Switch.* This development results in a two-fold reaction. It deoxidizes the hermetically sealed metal case, and forms an arc-blanketing agent which eventually ends arcing. It is believed the longer Durakool operates the more efficient it becomes. Its performance is guaranteed for 3 years.

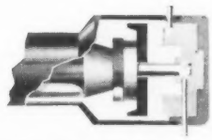
Today, Durakool is operating on devices requiring 2400 breaks per minute, 25,000 breaks a day, on induction motors up to 75 h.p., on 200 amp. circuits at 220 volts, and 140 amp. at 550 volts. In standard tests, Durakool Switches have withstood service at 2300 to 5500 volts.

The prime importance of these advances is the broad avenue of savings, economy and freedom from trouble opened up, the emergence of a new "tool" for product betterment, and simpler means of achieving difficult objectives.

## BIG Users

Leading manufacturers have already discovered the amazing advantages of this revolutionary mechanism. Big users say that Durakool withstands service no other switch can handle, is impervious to mechanical shock. They say *they never have had to replace a Durakool!* It is safe, foolproof, compact; inexpensive and simple to apply; it saves money, simplifies design and eliminates parts. It has unfailingly accurate, unvarying time characteristics, operates even on 2 degree angles . . . and is moisture-proof, corrosion- and explosion-proof.

The product, the principle, is there. It is just a case of applying it to suit your needs. And Durakool is so simple, "clean," dependable, versatile and flexible, that application is very simple. Durakool engineers will work with you to the very limit. Inquiries are invited. Descriptive literature will be sent without obligation. DURAKOOL, Inc., 1007 North Main Street, Elkhart, Indiana.



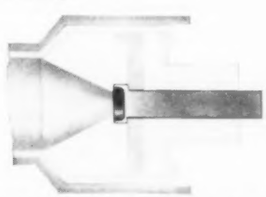
**Slight Changes Cover Special Needs**—Change of liquid fill quantity adapts Durakool to various needs. Where few contacts per day are required, or switch is subject to excessive mechanical vibration, a larger quantity is used. When several contacts per hour are necessary, a different type and quantity of fill are used.

**Extra Fast or Slow Operation**—On rapid operation, added heat is generated. Here a larger ceramic cup holding a larger retained body of mercury is used, increasing the surface area of contact. Larger body of mercury aids heat dissipation.

On slow motion, a smaller ceramic cup and retained body of mercury is used. Circuit is thus controlled by a narrower operating angle.

**Wide or Narrow Operating Angles**—Where weight, overhang, fast motions, or wide angles are important, Durakool uses shorter body of metal and moving mercury. Compact construction is less sensitive to vibration and bumps.

Durakool Switches with longer bodies of metal and moving mercury operate on smaller angles. With shallow ceramic cup and small body of retained mercury, they function at minimum angle.



**Increased Voltages**—By using a ceramic, a larger metal envelope and an electrode of smaller capacity and increasing distance between flexible lead connections, Durakool can operate on higher voltages at capacities equivalent to the electrode size. Durakools of this type have successfully been tested on 2300 and 5500 volts.

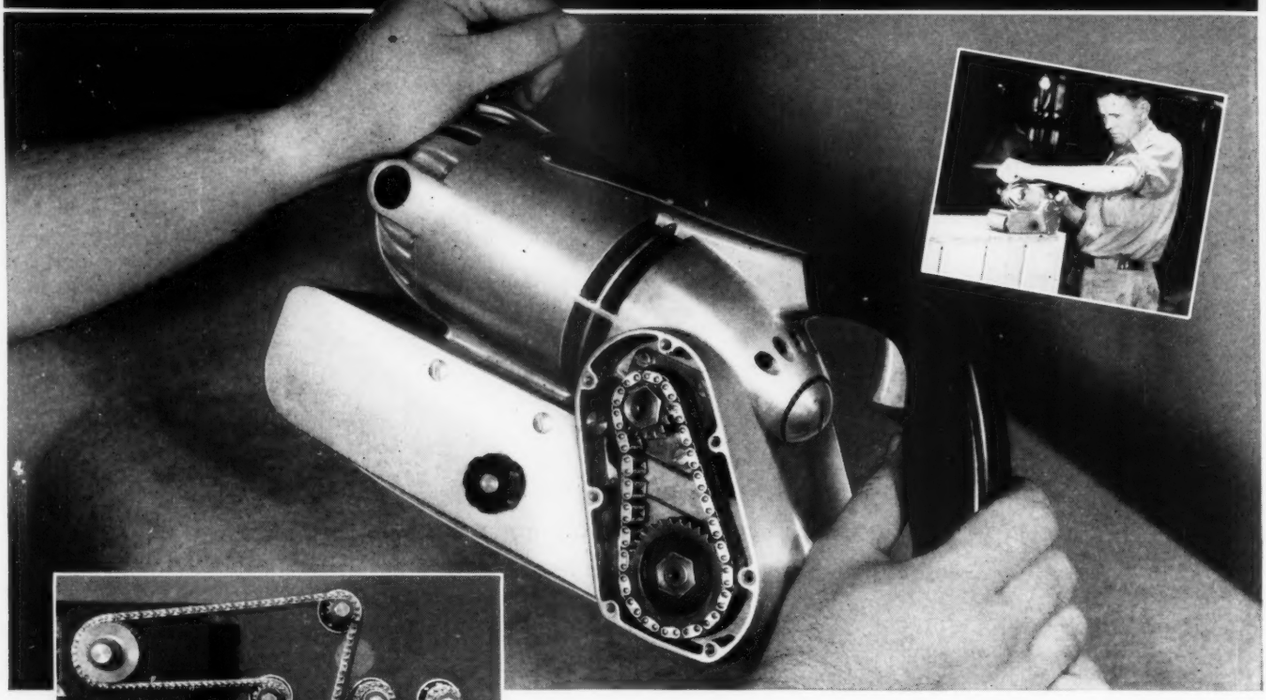
Typical of Durakool versatility and advantages is this Fuller-Kinyon unloader. The operator stands above with control in his hand. The machine obeys the movement of his hand.

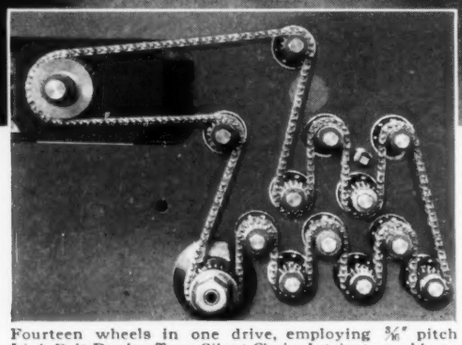
## 5500 KNOWN APPLICATIONS

With the revolutionary advances which Durakool has introduced to the art of mercury switching, Durakool switches, tubes and relays are being applied to a greater range of applications than ever dreamed possible. 5500 known uses have already been discovered. A few of the more outstanding uses are listed below.

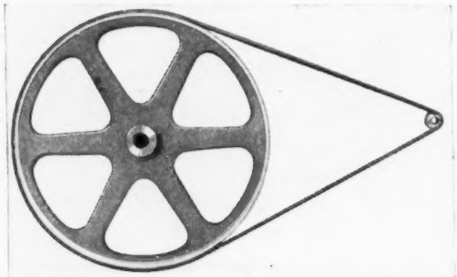
Air conditioning machine controls
Bookkeeping machines
Coal stokers
Diesel engine cut-outs
Elevator inter-locks
Fence chargers
Float switches
Furnaces
Motor vehicle safety switches
Phonographs
Pressure controls
Printing presses
Pumps
Steam boiler safety controls
Toilets—marine

# MAKE YOUR FRACTIONAL H. P. DRIVES
# QUIET, POSITIVE, COMPACT, COOL-RUNNING

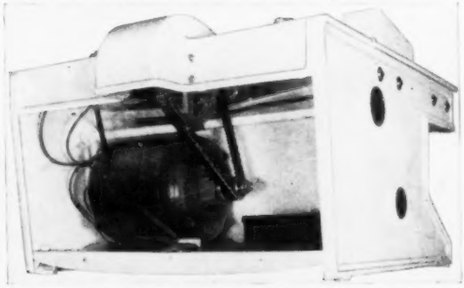




Fourteen wheels in one drive, employing 3/16" pitch Link-Belt Duplex Type Silent Chain. Intricate problems easily solved.



There is no limit to the range of reductions. Pinion, 23-teeth; driven wheel, 345-teeth as used on timing control drive.



1/4-H.P. Link-Belt Silent Chain Drive, using 3/16" pitch x 15/32" wide middle guide silent chain, 6 15/16-inch centers, operating retail bakery bread slicer; pinion, 21-teeth; driven wheel, 84-teeth.

## USE LINK-BELT 3/16" SILVERSTREAK SILENT CHAIN

Mr. L. E. Parker, Chief Engineer of Skilsaw, Inc., Chicago, says:

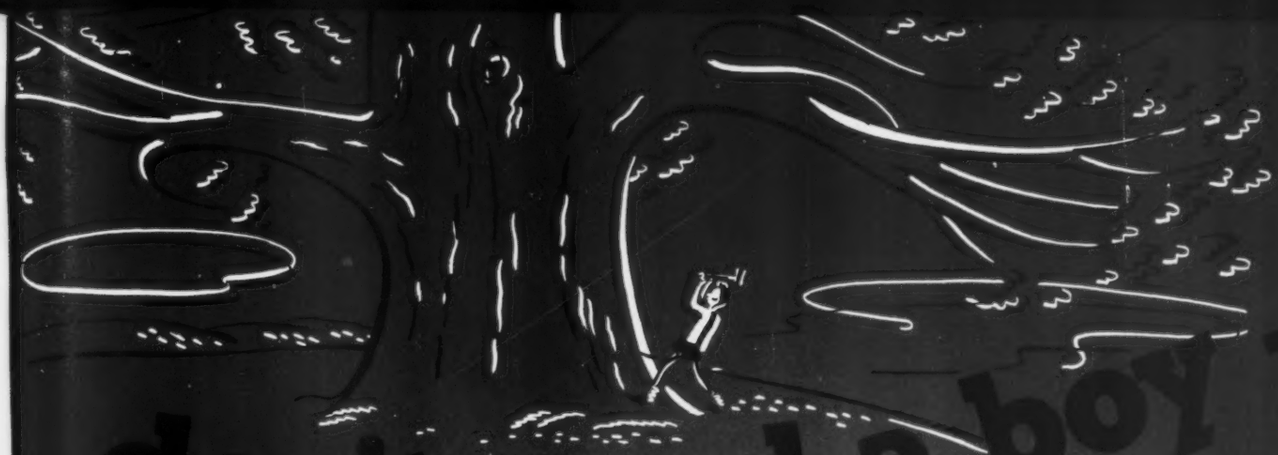
"A highly desirable feature in the design of our Zephyrplane 3" belt sander (illustrated above) is speed reduction by worm and worm wheel in connection with a 3/16" pitch x 15/32" wide Silverstreak silent chain drive. This drive was selected because of its compactness, smoothness of operation, efficiency and cool-running qualities, which are of vital importance in the design of portable electric tools."

Like Mr. Parker, many other machine designers have found this drive to be the ideal solution of problems calling for a positive, quiet, flexible drive for fractional horse power units. It is made in three types—middle guide, side flanged and duplex. The middle guide and side flanged chains are employed where all shafts are driven in one direction, and duplex where reverse direction is desired on some shaft or shafts, or where adjustment features are required.

If you have a troublesome belt or gear drive, or desire assistance on a new design, submit full details to our nearest office, or direct to

**LINK-BELT COMPANY** 7868

519 N. Holmes Ave. Indianapolis, Indiana



# don't send a boy!

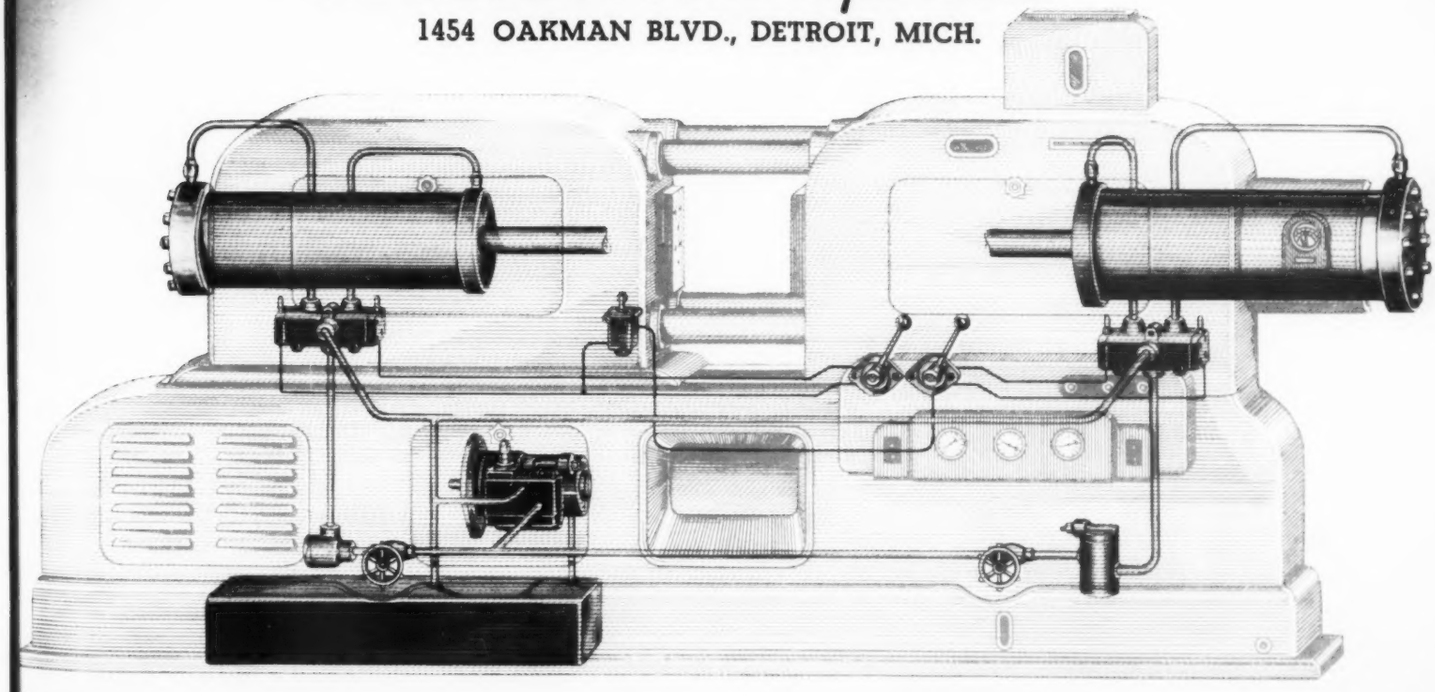
IN THE GREAT PLASTICS INDUSTRY (as an example), hydraulic controls must do a real man-sized job. For years Vickers pumps and hydraulic controls have been used as standard equipment on most of the leading makes of injection molding machines—and millions of plastics products have been quietly and efficiently produced with the Vickers Hydromotive Power developed.

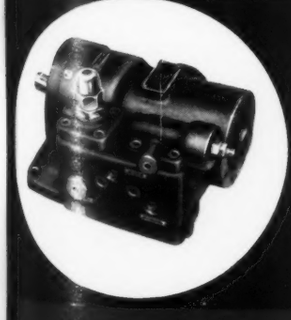
This is but one example of the gruelling day-in and day-out service expected of Vickers equipment. Massive hydraulic presses, light, fast, automatic machines, hard-working machine tools of every kind—they all rely on Vickers controls for their Hydromotive Power.

Your power application and control problem can be solved hydraulically—ask Vickers.

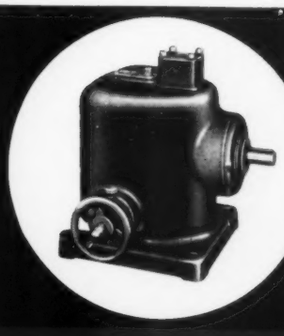
## VICKERS *Incorporated*

1454 OAKMAN BLVD., DETROIT, MICH.

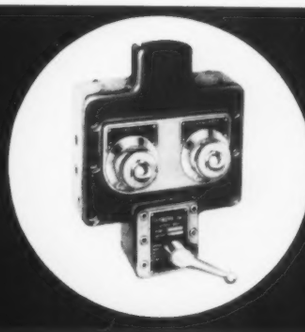




Vickers Double Pump and Combination Valve Unit has quiet operation and pressures to 1000 lbs. per sq. in. for continuous duty.



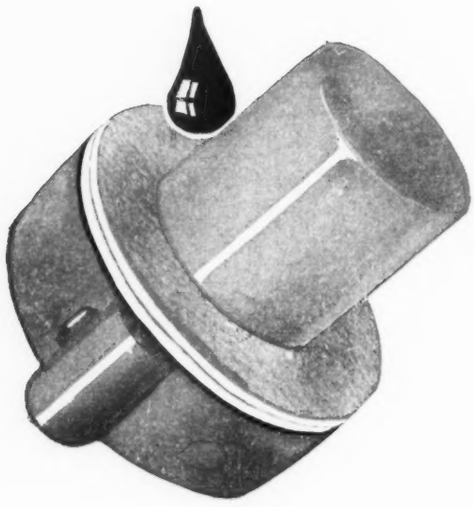
Vickers Variable Delivery Pump has multiple piston variable displacement construction of new and improved design.



Vickers Electric-Hydraulic "Traverse & Feed" Panels are available in several types and sizes.

# Dufelt*

## *A Low Cost, Serviceable OIL SEAL*



DUFELT, a combination of Certified Felt and Neoprene, has proven itself in actual use to be an effective oil seal for machinery. Made of materials that will withstand hard usage, heat or cold and deterioration, Dufelt fits admirably into the oil sealing picture.

Our engineers will be glad to diagnose your oil sealing problem and to suggest the proper Dufelt or perhaps a plain felt oil seal that will fit your particular situation best. Write our nearest office today.

* *U. S. Patent No. 2005934*

**THE FELTERS COMPANY, INCORPORATED • 210 South Street, Dept. BC, Boston, Mass.**

*OFFICES: New York, Philadelphia, Chicago, Detroit, St. Louis* *SALES REPRESENTATIVES: Dallas, Los Angeles, Louisville*

*MILLS: Johnson City, New York • Millbury, Massachusetts • Jackson, Michigan*

# NORTH...SOUTH...EAST...WEST

★ Available with Slotted Heads and Phillips Recessed Heads

## WORLD-WIDE DISTRIBUTION through reliable supply houses makes PARKER-KALON SCREWS available wherever you are!

This wide-spread distribution is evidence that Parker-Kalon Quality is known and recognized throughout the world. Moreover, it reflects universal acceptance and use of these cost-cutting, labor-saving fastening devices.

The world-wide availability of Parker-Kalon Screws means simply this: No matter *where* your business is, you can specify—and get—genuine Self-tapping Screws . . . each Screw possessing that high and unvarying standard of quality which assures unfailing performance.

PARKER-KALON CORPORATION
Dept. E, 190 Varick St., New York, N. Y.

### 4 REASONS WHY you can depend on Parker-Kalon Products

1. **UNEXCELLED LABORATORY FACILITIES . . .** the Parker-Kalon Laboratory which controls and maintains the high standard of quality for which Parker-Kalon Screws are so widely recognized, represents an investment of over $250,000.
2. **SPECIALIZED PRODUCTION EQUIPMENT . . .** is required to produce Parker-Kalon Self-tapping Screws and to maintain their uniformly high quality. The Parker-Kalon plant is famed as the most up-to-the-minute in the industry.
3. **FREE ENGINEERING SERVICE . . .** to help designers and production men obtain better fastenings at lower cost. Available throughout the country, Parker-Kalon Assembly Engineers render free service to both users and prospective users of Parker-Kalon Self-tapping Screws.
4. **AVAILABLE EVERYWHERE . . .** no matter where your plant is located there is a reputable supply house distributing Parker-Kalon Screws . . . assuring you a dependable source of supply.

# PARKER-KALON
## HARDENED
# *Self-tapping Screws*

INDUSTRY AFTER INDUSTRY
HAS FOUND THAT IT PAYS TO

# Bonderize

*Hope's windows were selected by Russell T. Pancoast, Architect, for above residence at Ft. Lauderdale, Florida. All Hope's windows are now Bonderized in their modern plant at Jamestown, N. Y.*

ONLY a short time ago Bonderizing was first introduced in the steel window industry. This proved to be such a successful quality and sales feature that within a matter of months it became practically standard practice in the field. Producer after producer equipped to apply this rust-inhibiting, paint-holding process to his production. So it has gone with automobiles, electric refrigerators, washing machines and many other industries.

It pays to give customers known improvements that they understand and appreciate.

Parker Processes are known the world over as most effective methods of inhibiting rust and holding paint to steel for long, durable life.

Maybe you, too, can Parker Process your production and gain a sales advantage.

**PARKER RUST PROOF CO. • 2179 E. MILWAUKEE AVE. • DETROIT, MICH.**

*Ask for This Book*

Send for a copy of the new Bonderizing Catalog showing the many benefits provided by this Parker Process.

**PARKER** *Processes* **CONQUER RUST**

BONDERIZING · PARKERIZING

# Only BRIGGS & STRATTON

## GIVES ALL SPEEDS TO ZERO . . .

## and Full Torque at Every Speed!

VARIABLE SPEED
BRIGGS & STRATTON
TRANSMISSION

## Accurate *Speed Control* Vital in These Applications

### Conveyors

Wide range—speed shiftable when stationary — full torque down to zero are important Briggs & Stratton Variable Speed Transmission advantages for conveyor drives.

### Pumps

Briggs & Stratton Variable Speed Drives greatly extend the usefulness of pumps by providing everyday ranges up to 20:1 and more.

### Feeders

Briggs & Stratton Variable Speed Transmissions on proportioning feeders give a useful range of delivery up to 50 to 1 with hairline accuracy to dial setting. These units do more and reduce feeder costs.

### Printing Presses

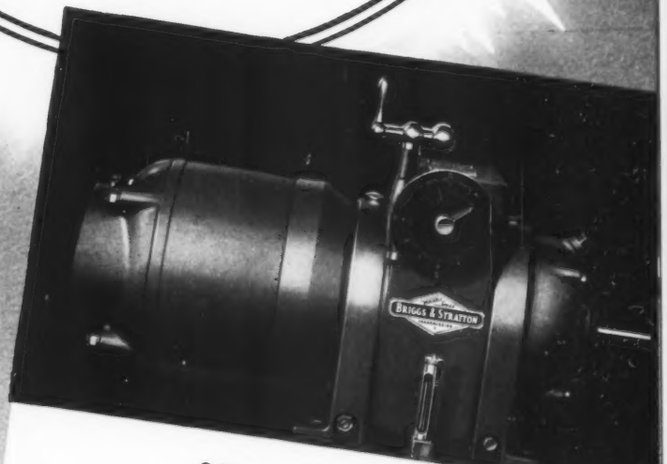
Another application where extremely accurate control of speeds down to zero sets new standards. Make-ready, running — inching without stopping the motor — all printing operations are simplified with Briggs & Stratton Variable Speed Drives.

### Welding Tables

On rotating chucks for speeding up welding operations — Briggs & Stratton Variable Speed Drives give the extreme speed range needed—fine adjustment — accurate regulation.

• • •

***Send for bulletin TP 401, which describes and illustrates Briggs & Stratton Variable Speed Transmissions.***




### SPECIFICATIONS

*Dimensions* — no bigger in diameter and no longer than the motor — no added fastenings required.

*Drive* — available with built-in motor or with shaft extension for coupled motor or offset drive.

*Input Speed* — maximum of 1800 RPM in smaller units — 1200 RPM in larger sizes — or can be connected to shaft of machine to run at low input speed.

*Delivered Speeds* — (with 1200 RPM input) in infinite steps from 330 RPM to 0 in standard types; from 165, 80 or 45 to 0 in built-in gear reduction types; or, from 1320, 1100, or 660 to 0 in built-in gear step-up types.

*Overhung Loads* — full chain pull capacity corresponding to torque rating.

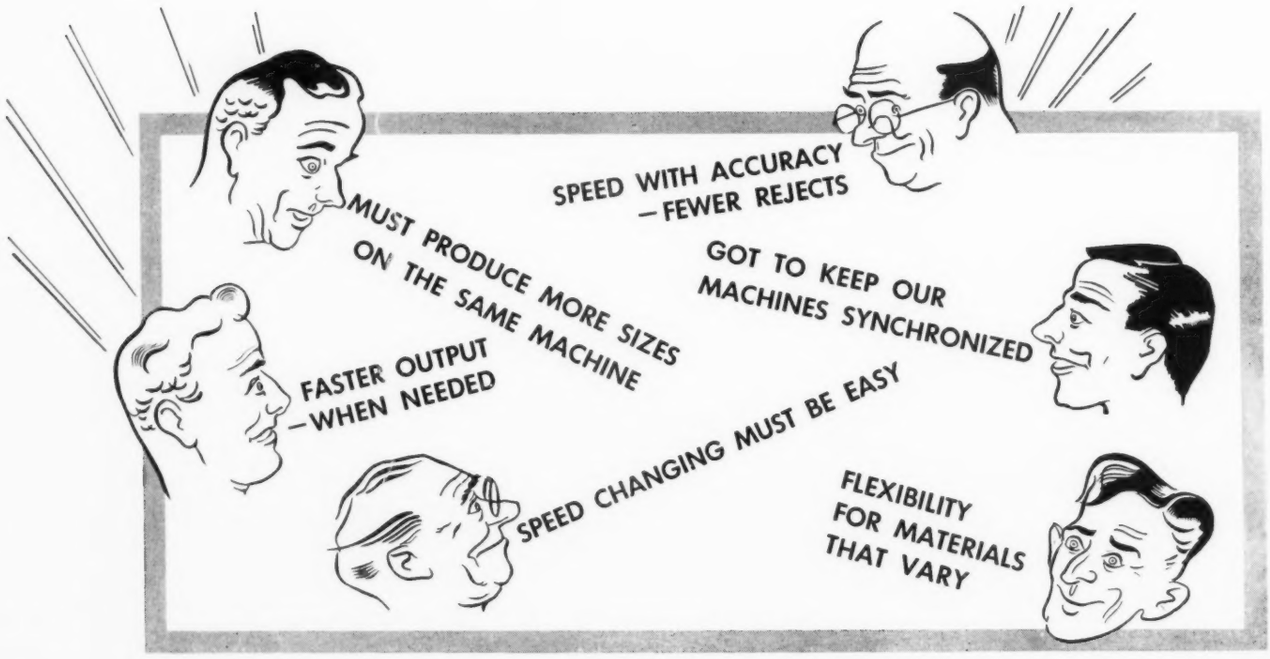
*Control* — standard manual, remote manual, remote electric or lever.

*All-Metal* — splash lubricated, runs in oil, no belts.

*Prices* — comparable to conventional drives.

**BRIGGS & STRATTON CORPORATION, Milwaukee, Wisconsin, U.S.A.**

Exclusive Licensee under Graham Transmissions, Inc.




# ARE BUYERS OF PRODUCTION MACHINES *Asking Too Much?*

## Builders of 1328 Different Machines Don't Think So—and Standardly Provide Accurate REEVES Speed Control

● In the final analysis, it is *what a machine will do*, that determines how it will sell. Even when it is purchased to turn out a certain standardized product, variations are constantly occurring in materials, skill of operators, and required volume of production.

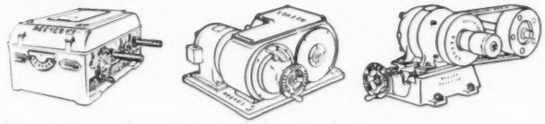
But rarely indeed is the operation of any machine so definitely fixed. Owners want to make different items out of different materials. They want to speed up or slow down production to meet all sorts of conditions in materials and in quality and quantity of work, all requiring *different speeds* for desired results.

Why not equip *your* machines so your customers can operate them *at any speed they need?* There's a REEVES Speed Control unit which you can incorporate in your machine with little or no change in design or manufacturing. The cost will be considerably less than you would expect, and your customers will have all the advantages of proved dependability.

No other speed control manufacturer is so well equipped to serve you—no other has such a wide range of units, sizes, mountings, and controls to choose from, and no other has had such long, and practical experience in adapting these units to different types of machines. REEVES Speed Control is infinitely adjustable, accurate, and positive. It builds sales and good will for any machine to which it is applied. Send for new catalog G-397 which describes REEVES Speed Control and its use as standard equipment by builders of 1328 different machines.

**REEVES PULLEY COMPANY, DEPT. K, COLUMBUS, INDIANA**

## THE 3 BASIC REEVES UNITS



The complete REEVES line is the result of many years of continuous development in which three basic units, with adaptations meet all requirements. *Left*, The REEVES VARIABLE SPEED TRANSMISSION provides maximum accuracy and adjustability over a wide range. Made in open and enclosed, vertical and horizontal units. Thirteen sizes—fractional to 75 h.p. Speed Variations 2:1 to 16:1 inclusive. *Center*, VARI-SPEED MOTODRIVE, includes motor, speed varying mechanism and reduction gears (where required) in one compact unit. Five sizes, horizontal and vertical types, ¼ to 10 h.p. Speed variations 2:1 to 6:1 inclusive. *Right*, VARI-SPEED MOTOR PULLEY, simplified development of transmission. Mounts on standard shaft of any constant speed motor and forms direct drive to machine. Ten sizes, fractional to 15 h.p.; 3:1 range of variations.

# *Reeves* SPEED CONTROL

# INJECT *New Salability* INTO YOUR PRODUCTS

## with Versatile Bakelite Plastics

**HEAT-RESISTANCE** and permanently lustrous finish are obtained by forming Toastmaster handles and bases from Bakelite Molded.

**MOISTURE-RESISTANCE** and mechanical toughness in the receiving cup of Dazey Ice Crusher are provided by Bakelite Molded.

**CHEMICAL-RESISTANCE** and delicate opaque and translucent coloring are achieved in these Cosmetic Closures with Bakelite Polystyrene.

**DIELECTRIC STRENGTH** and mechanical toughness in this Electric Tool are furnished by impact-resistant Bakelite Molded housings.

**IMPACT-RESISTANCE** combined with resistance to brine and damp air is supplied by Bakelite Molded in this Salt Water Fishing Reel.

FINER STYLING, better operation or longer service life...often you can incorporate *all three* of these important sales stimulants into your manufactured products by fabricating them from versatile Bakelite Plastics!

There are more than 2000 of these materials from which accurate selection can be made...offering a wide diversity of special properties in uniquely useful combinations . . . as well as a rainbow-like array of colors in transparent, translucent and opaque effects. There are phenolic, polystyrene, urea, cellulose-acetate and other basic types.

Give your products the added inherent values now available through use of Bakelite Plastics. Assure quick selection of the right *type* of plastics by consulting Bakelite Plastics Headquarters *first*. Write for simplified reference outline of plastic materials and their uses . . . illustrated Booklet, 22P, "New Paths to Profits."

---

Bakelite Corporation, 247 Park Ave., N.Y.
*Chicago:* 43 East Ohio St. *Bakelite Corporation of Canada, Ltd.*, 163 Dufferin St., Toronto *West Coast:* Electrical Specialty Co., Inc., San Francisco, Los Angeles and Seattle

**BAKELITE**

The registered trade marks shown above distinguish products manufactured by Bakelite Corporation, under its control, from similar products.

**PLASTICS HEADQUARTERS**

¼" "HORNET": Exceptionally compact production drill, specially designed for airplane assembly; full ball bearing; rugged gears and spindles; comfortable in the hand.
THE BLACK & DECKER MFG. CO. ELECTRIC B&D TOOLS TOWSON, MARYLAND
¼" "HOLGUN": Advanced new drill of surprising compactness and ample power for production service; famous "Pistol Grip and Trigger Switch"; full ball bearing.
Single Row Ball Bearing
Shielded Type, Single Row Ball Bearing
Single Felt Seal Shielded Ball Bearing
"NORMA-HOFFMANN"
PRECISION BEARINGS

*have been used in*

# BLACK & DECKER PORTABLE TOOLS

The "Holgun" and "Hornet" Electric Drills here pictured are recent additions to the distinguished line of portable tools made by Black & Decker Manufacturing Co., Towson, Md.

Like so many other "B. & D." units built in the last 20 years, these advanced tools are NORMA-HOFFMANN equipped. Armature and intermediate shafts, and chuck spindle, are carried on PRECISION BEARINGS—single-row, felt-sealed, and shielded types—at speeds ranging from 750 R. P. M. at the chuck spindle, to 14,000 R. P. M. in the motor.

Since Black & Decker began using them in 1918, they have found that the PRECISION characteristics, high speed qualities and dependability of NORMA-HOFFMANN Bearings provide the requisite long life, smooth operation and efficiency in their units.

*Since*

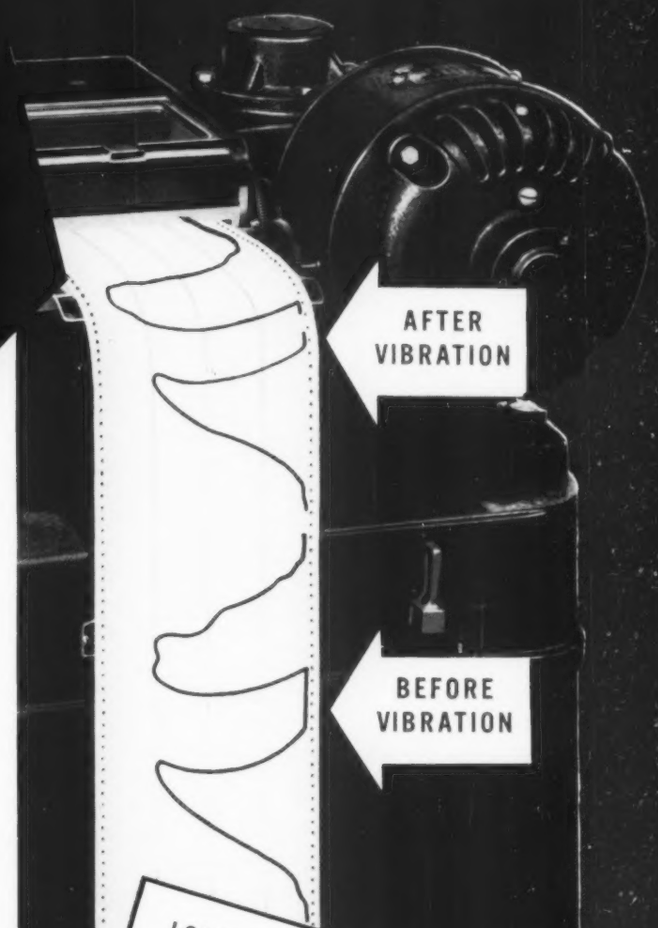
# 1918

*There's a PRECISION BEARING for every load, speed and duty. Write for the Catalog. Let our engineers work with you, on your bearing problems.*

**NORMA-HOFFMANN BEARINGS CORPORATION, STAMFORD, CONN., U. S. A.**

# CONSIDER THIS RECORDED EVIDENCE

## of SHAKEPROOF Locking Power




### ACTUALLY LOCKS TIGHTER UNDER VIBRATION!

External Type

Internal Type

Countersunk Type

External-Internal Type

Hundreds of scientifically conducted tests on precision-built testing machines give factual evidence of the outstanding locking efficiency of Shakeproof Lock Washers. Of particular interest is the data secured from tests on the Maximeter, an electrically operated machine which graphically records the torque force values required to tighten and loosen nuts and screws. These tests conclusively prove that while Shakeproof Lock Washers hold tightly on initial contact, they actually lock tighter after exposure to vibration — your assurance that vital connections locked with Shakeproof will stay tight.

**SHAKEPROOF LOCK WASHER CO.**

*Distributor of Shakeproof Products*
*Manufactured by Illinois Tool Works*

**2549 North Keeler Avenue • Chicago, Illinois**

Plants at Chicago and Elgin, Illinois In Canada: Canada Illinois Tools Ltd., Toronto, Ont.

Copyright 1939 Illinois Tool Works

**FREE!**

A small kit containing samples of Shakeproof Products will be sent upon request.

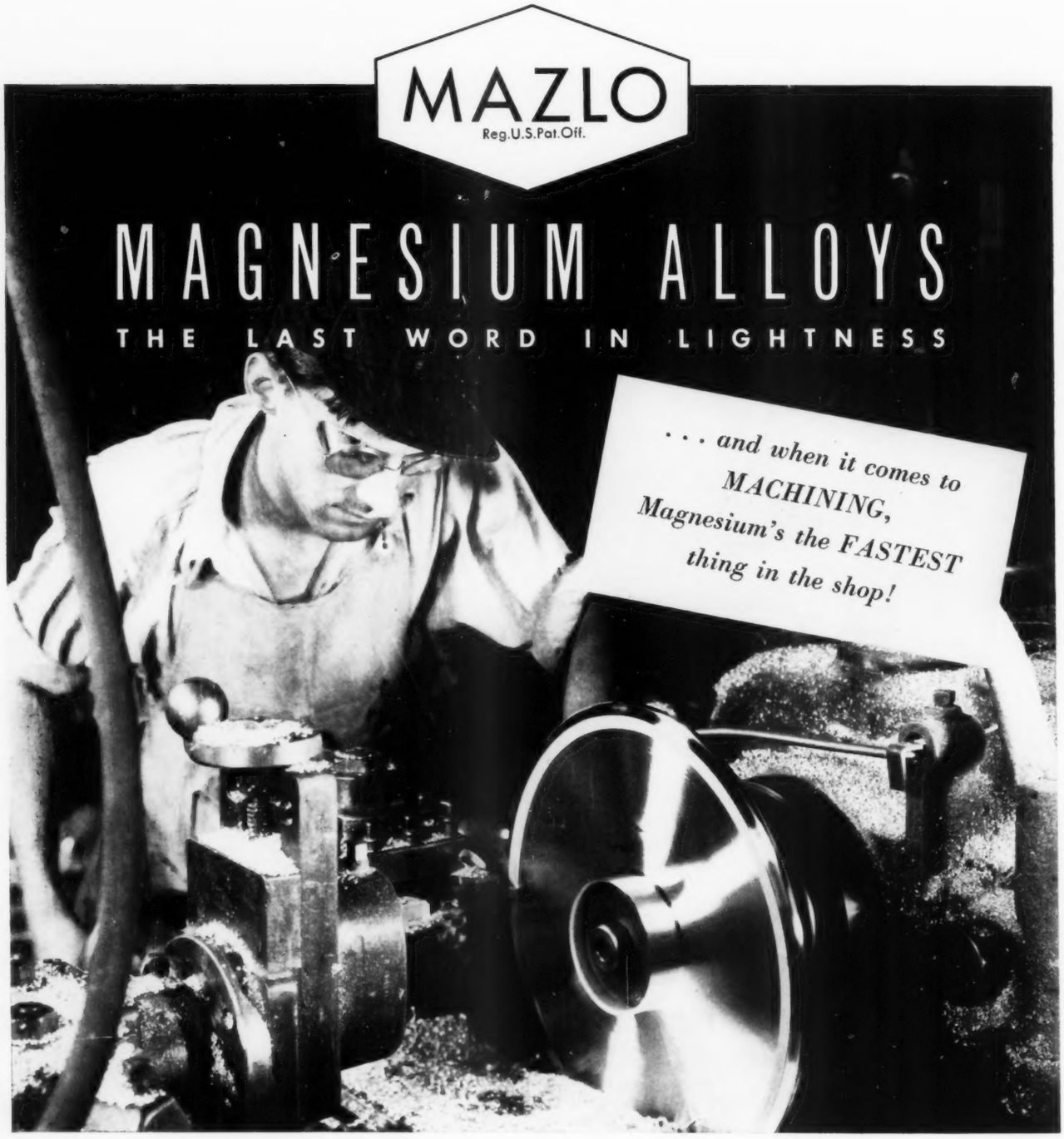
### LOCKING EFFICIENCY SCIENTIFICALLY PROVED!

The Maximeter graph above shows the recording of the torque force values required to tighten and loosen a nut locked with a Shakeproof Lock Washer—both before and after vibration. Detailed explanation of these tests will be furnished to metal product manufacturers on request.

"Fastening

# SHAKEPROOF

Headquarters"


MAZLO
Reg.U.S.Pat.Off.
MAGNESIUM ALLOYS
THE LAST WORD IN LIGHTNESS
. . . and when it comes to MACHINING, Magnesium's the FASTEST thing in the shop!

MAZLO Magnesium finishing costs are low, for it machines at high speeds. No tendency to tear, drag, chip out or heat up excessively. MAZLO Magnesium takes a fine, smooth finish. Because of its freedom from porosity and hard spots, you'll find that it greatly reduces your scrap losses.

These savings often completely offset the higher per pound cost for Magnesium. At no additional cost, or only slightly more, you obtain the impressive weight-saving advantages of this lightest of commercial materials.

MAZLO Magnesium Alloys provide a range of physical and fabricating characteristics which enable you to go *very* light economically. MAZLO manufacturing facilities offer you Magnesium in every form: Sand castings, permanent mold and die castings, extruded bar and shapes, sheet, tubing and forgings.

*Sales Agent:* Aluminum Company of America, 1702 Gulf Bldg., Pittsburgh, Pa.

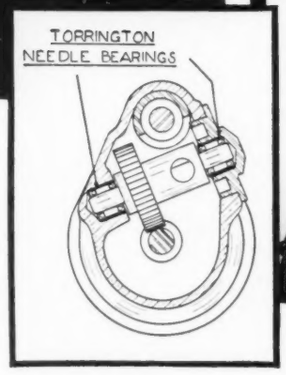
MAZLO

AMERICAN MAGNESIUM CORPORATION

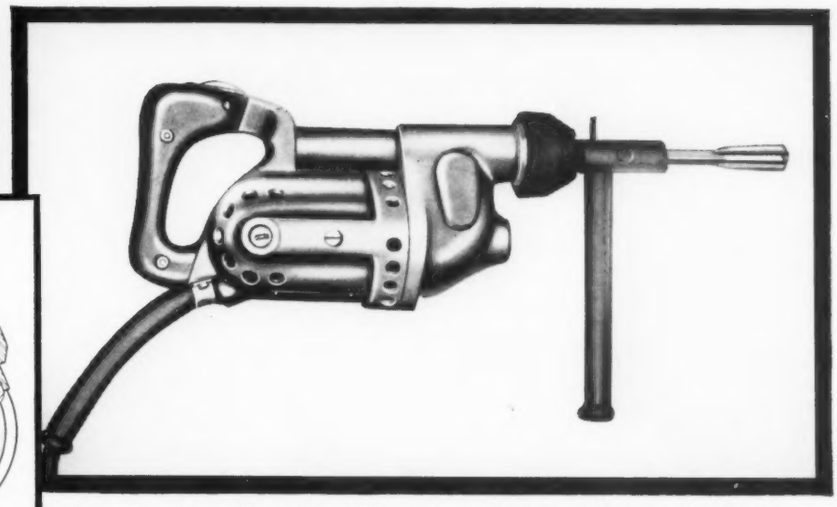
# "WE GET BETTER LUBRICATION ON TOUGH JOBS WITH THE TORRINGTON NEEDLE BEARING"

## SAY MAKERS OF WODACK ELECTRIC TOOLS

(*Above*) Wodack engineers designed the Wizard Electric Hammer for ruggedness, light weight and ability to run long periods without servicing




(*Right*) Cross-section showing how the Needle Bearings are mounted on the trip pin spindle.



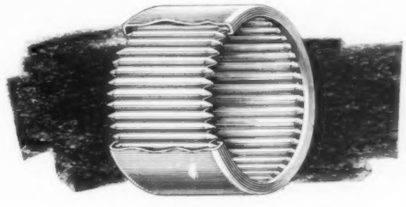
The light, high-speed Wizard Electric Hammer in which two sets of Torrington Needle Bearings transmitted 576,000,000 pounds of energy without additional lubrication—and with no signs of wear.

FOR their light-weight, hard-hitting Wizard Electric Hammer, engineers of the Wodack Electric Tool Corporation selected the Torrington Needle Bearing. In addition to small size and high unit capacity they secured a third important advantage—*better, longer lasting lubrication.* But read their own report . . .

"A stock Wizard Hammer was operated for 100 hours continuously day and night without additional lubrication on any of the working parts. Upon its disassembly, it was found that the bearings showed no signs of wear and appeared as good as new.

"The plunger strikes 2,400 times per minute, which is 144,000 times per hour. Therefore, in the 100-hour test, this part operated 14,400,000 times. At each actuation a blow of 40 pounds was struck, which totals 576,000,000 pounds of energy developed during this test period. *All of this energy passed through the two Torrington bearings, which are mounted on the trip pin spindle that operates the plunger.*

"Inasmuch as a certain amount of heat is developed during a test run of this nature, several of the parts were about to run out of lubrication. *However, the*



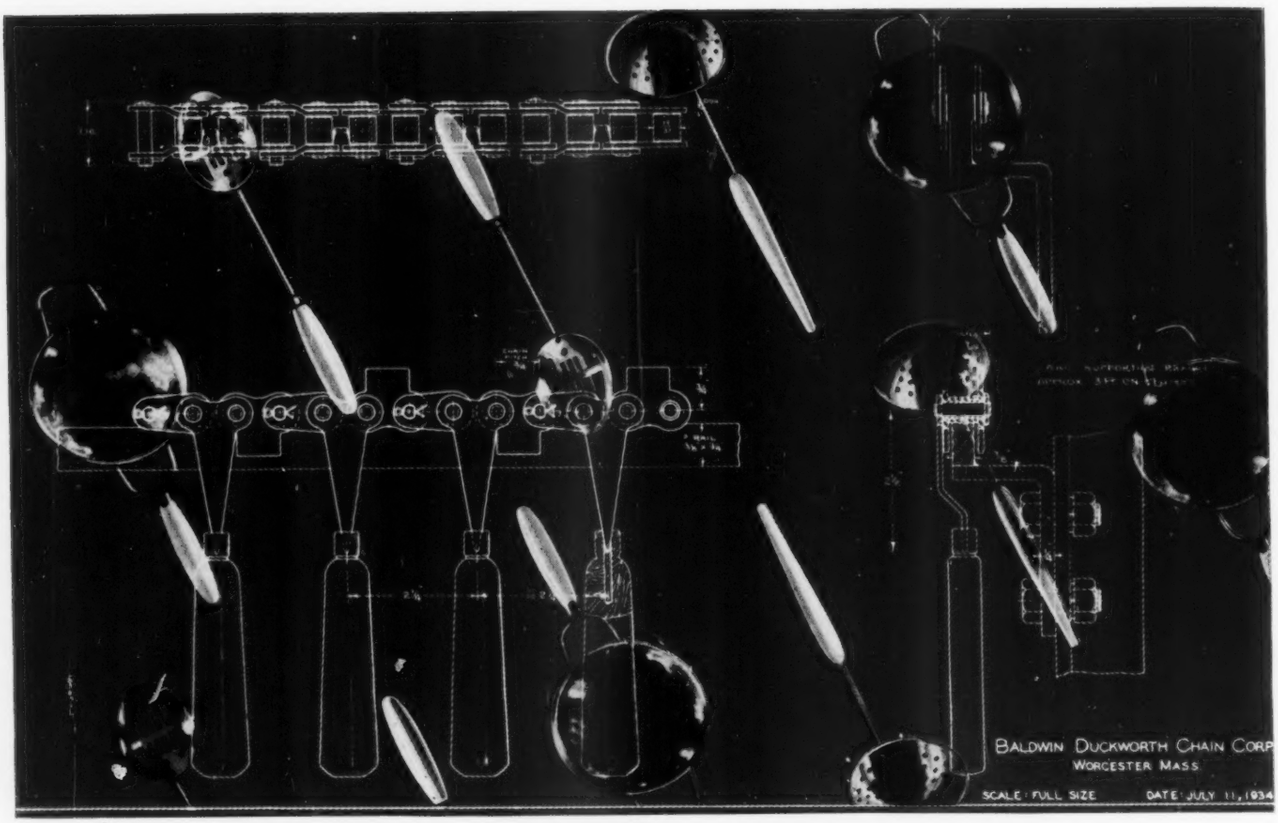
*Torrington bearings with their unique characteristic of retaining lubricant were in very good condition.*" (Italics are ours).

And that is not all. The Needle Bearing is an inexpensive, easily-installed, compact unit that makes recognizable savings on assembly costs. Let the Torrington Engineering Department tell you more about this and perhaps suggest ways in which the Needle Bearing can give you exclusive advantages.

For further information write for Catalog No. 8. For Needle Bearings to be used in heavier service, request Booklet 103X from our associate, the Bantam Bearings Corporation, South Bend, Ind.

*The Torrington Company*
ESTABLISHED 1866
*Torrington, Conn., U.S.A.*
*Makers of Ball and Needle Bearings*
New York Boston Philadelphia Detroit
Cleveland Chicago London, England

**TORRINGTON**
**NEEDLE BEARING**

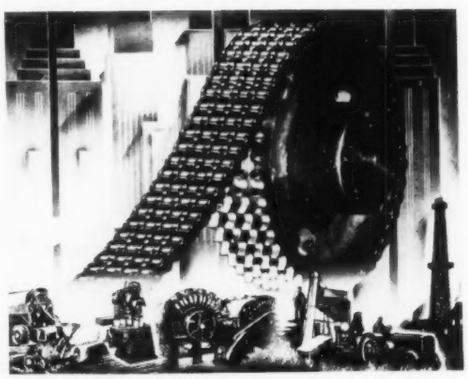



# BALDWIN CHAIN

## Cuts Costs in the Finishing Department

This blue print shows how Baldwin engineers eliminated an expensive operation for a utensil manufacturer who previously hand-dipped his handles. Now he saves money, gets more production—and because Baldwin roller chain is positive in action he turns out more uniform and more attractive handles for his many products.

Perhaps you need accurate timing of some complicated machine instead of a relatively simple conveyor, like the one shown here. All the more reason to avail yourself of the many years of experience stored up in the Baldwin Engineering Department. And, in signing off, let us hint that the advantages of roller chain in positive control and long effective life are not costly; in fact, they often are the most inexpensive, even in first cost.



**A FEW QUALITIES OF ROLLER CHAIN**

cannot slip
absorbs shock
resists heat, corrosion
unaffected by dirt, dust
any power, any speed
operates quietly
low maintenance
lowest cost

BALDWIN-DUCKWORTH
*Division of Chain Belt Company*
Springfield, Mass.
*Factories at Springfield and Worcester, Mass.*

**BALDWIN-DUCKWORTH**
DIVISION OF CHAIN BELT COMPANY

### YOU are Building the World of Tomorrow

Important to you, therefore, is the consolidation of the Chain Belt Company of Milwaukee and the Baldwin-Duckworth Chain Corporation of Springfield and Worcester, Mass. Whether you are equipping a plant or processing materials this merger can help you to do it better, more profitably.

*Back of every*

# PERFORMANCE RECORD

# A GOOD BEARING

● When you read of the new performance records established in the Automotive field . . . stop and think of the bearings. Consider the important part they play in achieving the results . . . how they affect the performance of any motive unit. Then you will realize why all great records are founded on GOOD BEARINGS.

Would you like to increase the performance of your product? Would greater speed, longer life or increased accuracy add to your sales appeal? Then check the size . . . the alloy . . . the design of your bearing.

A Johnson engineer will gladly assist you in this work. A competent staff of trained engineers and metallurgists are always available for the sole purpose of helping manufacturers get the most from their bearings. Producing ALL types of sleeve bearings enables us to base our recommendations entirely on facts . . . free from prejudice. This exceptional service is offered without obligation.

**PRODUCTS OF JOHNSON BRONZE**

Cast Bronze Bearings — Graphited Bearings — Sheet Bronze Bearings — Sheet Bronze Graphited Bearings — Bronze Backed Babbitt Lined Bearings — Steel Backed Babbitt Lined Bearings — Steel Backed Bronze Lined Bearings — Electric Motor Bearings — UNIVERSAL Machined Bars — Automotive Replacement Bushings — Locomotive and Mill Bronzes — Car Brasses — Tin and Lead-Base Babbitt — Miscellaneous Bronze and Brass Castings — Ledaloyl Self-Lubricating Bearings — Steelbond Bronze.

The MOST COMPLETE SLEEVE BEARING SERVICE in the world

**JOHNSON BRONZE COMPANY**

*Sleeve* **BEARING HEADQUARTERS**

**508 SOUTH MILL STREET • NEW CASTLE, PA.**

*TYPHONITE ELDORADO PENCIL PAGE

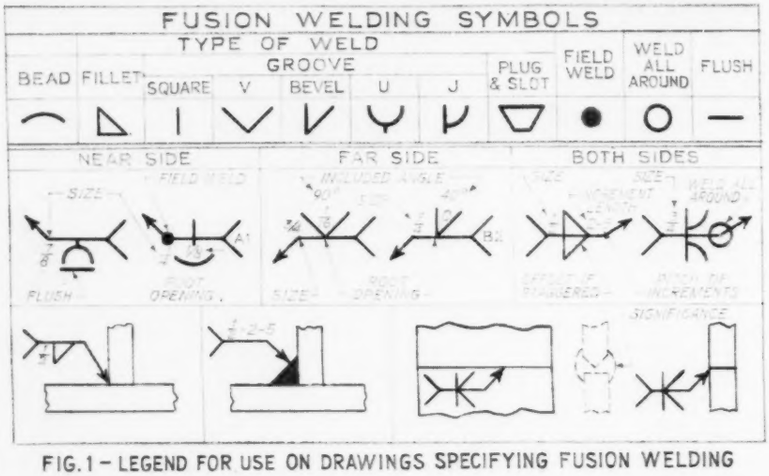



FIG. 1 – LEGEND FOR USE ON DRAWINGS SPECIFYING FUSION WELDING

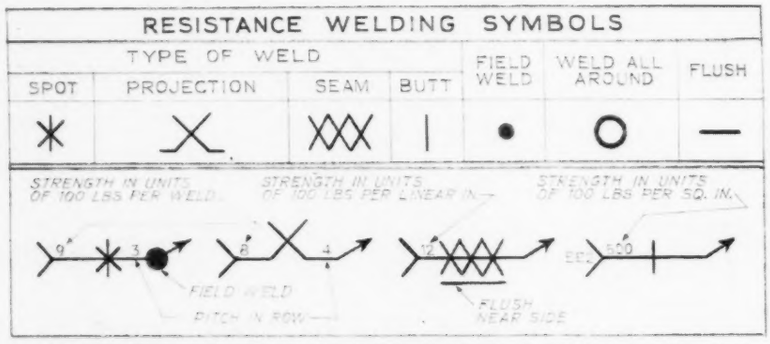



FIG. 2 – LEGEND FOR USE ON DRAWINGS SPECIFYING RESISTANCE WELDING

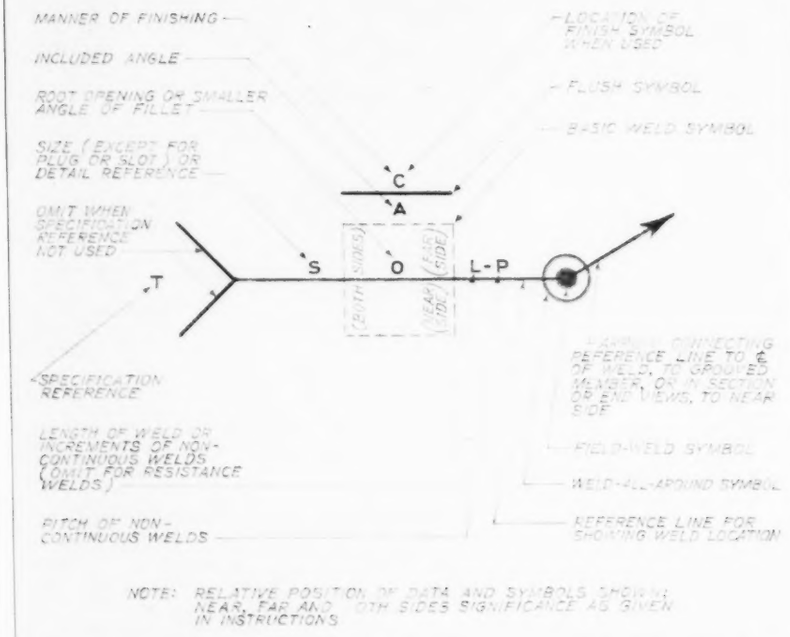

MANNER OF FINISHING
INCLUDED ANGLE
ROOT OPENING OR SMALLER ANGLE OF FILLET
SIZE (EXCEPT FOR PLUG OR SLOT) OR DETAIL REFERENCE
OMIT WHEN SPECIFICATION REFERENCE NOT USED
SPECIFICATION REFERENCE
LENGTH OF WELD OR INCREMENTS OF NON-CONTINUOUS WELDS (OMIT FOR RESISTANCE WELDS)
PITCH OF NON-CONTINUOUS WELDS
FLUSH SYMBOL
BASIC WELD SYMBOL
FIELD-WELD SYMBOL
WELD-ALL-AROUND SYMBOL
REFERENCE LINE FOR SHOWING WELD LOCATION
NOTE: RELATIVE POSITION OF DATA AND SYMBOLS SHOWN IN NEAR, FAR AND BOTH SIDES SIGNIFICANCE AS GIVEN IN INSTRUCTIONS

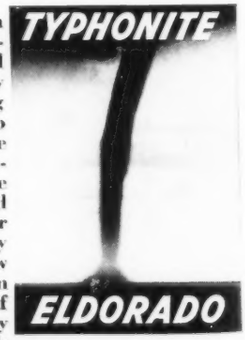
FIG. 3 – STANDARD LOCATION OF INFORMATION ON WELDING SYMBOLS

## *A Shorthand System of Welding Symbols*

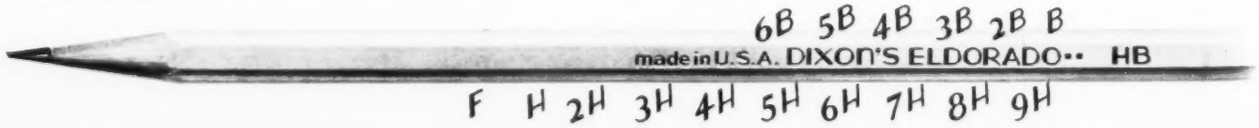
**The increased use of welding in machine construction, we believe, makes this chart of standards and symbols a real help to draftsmen. It gives a complete, standard language in which to talk and a means of putting down a huge volume of information accurately, with as few lines and figures as possible. The symbols given are the required standards set up by the American Welding Society.**

**FREE—Wouldn't you like to have a blueprint made from the original drawing to hang in your drafting room? You can get one free by writing to Pencil Sales Department, JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J. Ask for blueprint No. 20-J12.**

**And when you get this blueprint examine it carefully. The working drawing was prepared with Typhonite Eldorado Pencils using degrees H and HB. You'll then agree, we think, that Typhonite Eldorado's clean, opaque lines make the best blueprints.**




***TYPHONITE is a new form of natural graphite, used exclusively by Dixon in making leads for Eldorado Pencils. Typhonite consists of extremely minute particles produced by a whirlwind or typhoon of dry steam. This new exclusive Dixon process is one of the reasons why Eldorado pencils hold their points longer, give off freely and make such opaque lines and figures.**



*Sani-Way Tooth Brush Holder, produced by the Practical Products Corp., Indianapolis. Won Honorable Mention in Household Group. Designed by Barnes & Reinecke, 664 North Michigan Avenue, Chicago, and molded by Chicago Molded Products Co.*

*Baby Dyner, manufactured by Lockwood Products, 2061 Southport Avenue, Chicago. Won major award in Household Group. Designed by Alfred M. Mell, 30 North Michigan Avenue, Chicago. Molded by the Auburn Button Works. The base is black. The dish is orange Plaskon, the cup Primrose yellow Plaskon.*

*Valdor, Incorporated's container for its Don Juan Lipstick—famous in France, a newcomer in America. Won major award in Novelty Group. Shell is molded of jet black Plaskon. Universal Plastics is the molder.*

It is both a compliment and a coincidence that in the Fourth Annual Modern Plastics Competition, the judges selected three items that are being molded of Plaskon because of its recognized sanitary properties.

Molded Plaskon resists solvents. It is impervious to oils and greases. It can be immersed in alcohol and acetone for indefinite periods of time without harmful effect or bleeding of color.

Molded Plaskon is non-porous. It will not absorb odors or flavors. The surface is hard, easy to clean. Being solid molded color, the finish is permanent. Scratching or abrasion do not impair its color value.

If your product is such that you can take advantage of these remarkable qualities, be sure to investigate Plaskon, world's largest selling urea-formaldehyde plastic. Consultation entails no obligation.

**PLASKON COMPANY**
Incorporated
2126 SYLVAN AVE. TOLEDO, OHIO
*Canadian Agent:* Canadian Industries, Ltd., Montreal, P. Q.

Trade Mark Registered

# PLASKON

★ MOLDED COLOR ★

WAGNER
motor design
harmonizes with
modern streamlined
machines and
appliances
Streamlining has invaded the machine shop and the home. The modern trend is toward neater, more compact machinery. Sometimes the motor presents a problem in the streamlining of machinery, but not where Wagner motors are used, for Wagner motors are designed to harmonize with the most modern machinery and appliances. No longer must the motor be an unsightly appendage on an otherwise modern piece of equipment. Wagner motors are designed for compactness and neat appearance. They seemingly become an integral part of the equipment they operate.
Appearance is only one reason why more and more manufacturers are selecting Wagner motors for their modernized equipment. There are other reasons, too. Wagner motors are sturdy and reliable. Their record for performance and dependability is your assurance that they will give the kind of service you want your equipment to give. Wagner motors are so diversified in types and ratings that you can select the motor that exactly meets the electrical and mechanical requirements of each particular machine.
Wagner maintains 25 sales and service branches throughout the United States. Each branch carries a stock of motors ready for immediate shipment.
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# COPPER ALLOY BULLETIN

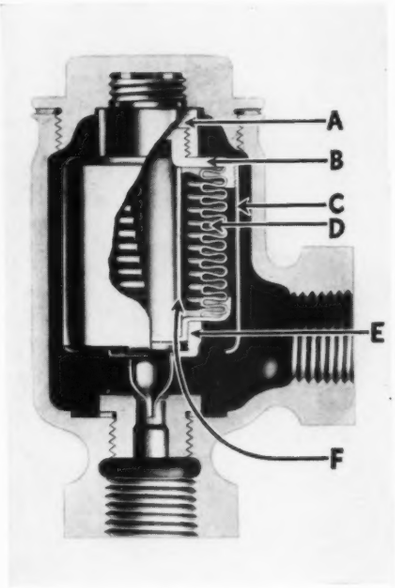
*Reporting News and Technical Developments of Copper and Copper-Base Alloys*

DECEMBER — "Bridgeport" BRASS CO. — 1939

## STEAM TRAP PARTS SHOW ADAPTABILITY OF BRASS

The ease with which brass can be adapted to different fabricating processes for the production of a variety of shapes is admirably illustrated in the Thermo-Static Steam Traps manufactured by Sarco Company, Inc. These devices apply the principles of steam trapping to high pressure heating and industrial process work, and are used for pressures up to 200 pounds.

Part A in the photograph is made from round bar stock, B is pressed from sheet




metal, C and F are made from brass tubes. D is made from tubes and also from discs fabricated into tubes by Sarco. E is formed from hexagon bar stock.

### Chromium Plating Method Produces Heavy Deposits

A new method for chromium plating is reported to be adapted for the production of heavy bright deposits. The method uses an aqueous solution containing about 250 grams of chromic acid and 1 to 5 grams of sulphate per liter. A current is passed to the article to be plated (which forms the cathode) at a density of at least 2 amperes per square inch. Temperature of the bath is maintained between 40 and 90 degrees C.

## SPRING QUALITIES OF PHOSPHOR BRONZE GIVE WIDE ENGINEERING USEFULNESS

### Strength, Ductility, Conductivity, and Corrosion Resistance Are Other Factors in Its Extensive Use in Many Applications

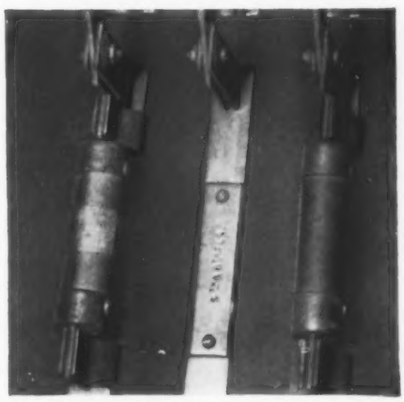
Notable among the copper alloys for its unique combination of desirable engineering properties, phosphor bronze is recognized as the most satisfactory alloy for many specialized applications.

The phosphor bronzes are alloys of copper and tin with small amounts of phosphorus. Two different compositions are given in the A.S.T.M. Specifications. The first is Phosphor Bronze A, containing 5% tin and 0.05 to 0.10% phosphorus, with the remainder copper. Phosphor Bronze C contains 8% tin, with the same amount of phosphorus as the A alloy. The phosphorus serves as a deoxidizing agent, just as it does in deoxidized copper, but it also increases the tensile strength.

#### Used for Spring Parts

The manufacture of spring parts is one of the outstanding applications of phosphor bronze. Here its high elasticity and resistance to fatigue under repeated bending are invaluable. Since phosphor bronze also has fair electrical conductivity, it is extensively used in switch and contactor parts, and fuse clips. Thermostatic bellows are another important use.

Other applications of phosphor bronze are the result of its high tensile strength, ductility, and resistance to corrosion by



The electrical industry is a large user of phosphor bronze. Spring qualities make this alloy especially suitable for such parts as fuse clips and spring contacts.

atmospheric conditions, dampness, and salt and acid waters. Such applications include bushings and valve parts. Still another extensive use is in paper-making machinery.

*(Continued on Following Page, Column 2)*

### Self-Cleaning Shower Head Makes Copious Use of Brass

Novel idea in shower heads is the patented self-cleaning feature of the Anystream Head, manufactured by Speakman Company, Wilmington, Del. The Anystream Head never stops up. The conventional holes for the spray are replaced by a set of plungers that give normal or needle

showers at the turn of a handle. A further turn of the handle gives a floor spray that quickly washes away all sediment.

For long life in this unique head, Speakman Company uses brass. Outer section of the head is cast. The plungers, lever handle, the clips holding plungers to face plate, and the screws holding the face plate to the head are all made from brass rod.

### Acetate and Thiosulphate Bath Colors Brass Blue

A blue color can be obtained on brass by using a solution of sodium thiosulphate and lead acetate, it is reported. Suggested quantities are 124 grams of thiosulphate and 38 grams of acetate for each liter of solution. The thiosulphate and the acetate are dissolved separately, each in a half-liter of water, and the two solutions are mixed just before use. Temperature of the bath should be about 60 degrees C., it is reported. A yellow-gold color is produced first, and is followed by the blue in about one-half minute.

# COPPER ALLOY BULLETIN

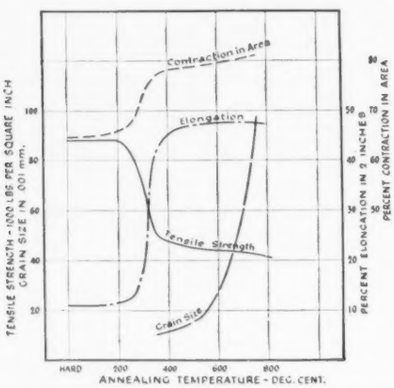
## ALLOYS OF COPPER

*This is the sixth of a series of articles on the properties and applications of the copper alloys, and continues the subject of Rich Low Brass.*

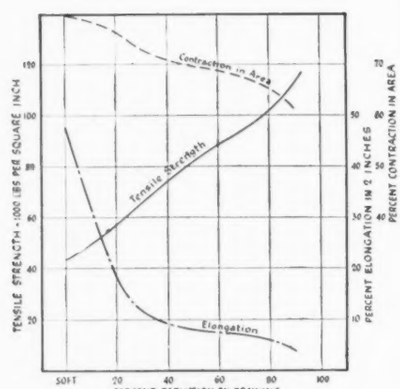
### RICH LOW BRASS

The most important physical properties of Rich Low Brass (85-15) were listed in this column last month. Compared with Gilding Metal (95-5) or Commercial Bronze, Rich Low Brass is appreciably stronger and is hardened more rapidly by cold working. Other changes in properties, such as conductivity, coefficient of expansion, and density, vary more nearly in proportion to the increase in zinc content. Effects of cold working and annealing wire of this alloy are shown in the accompanying graphs.

The high strength and ductility of Rich Low Brass are accompanied by excellent resistance to failure by season cracking and dezincification. It is a combination of these properties that makes possible the use of this alloy in applications requiring the ability to withstand stresses without failure by deformation or corrosion.




Effect of Annealing on Mechanical Properties of 85-15 Copper-Zinc Alloys.




Effect of Cold Drawing on Mechanical Properties of 85-15 Copper-Zinc Alloys.

### Wide Color Range Possible

The color of Rich Low Brass is also an important factor in its use. Alloys ranging between 82 and 88% copper show quite marked differences in color when the alloy is properly cleaned and polished. These slight differences in color have led to the use of several alloys of only slightly different copper content, depending upon the exact color desired. Most of such alloys find their use in the jewelry trade.

The alloy is also used to a considerable extent for water pipe and condenser tubes because of its resistance to dezincification and a slightly greater resistance to fatigue than high copper content alloys. Occasionally the alloy is modified slightly by the addition of small quantities of tin, in the belief that this increases the resistance to corrosion.

(The subject of Rich Low Brass will be concluded in next month's issue.)

## *Memos on Brass—No. 4*

The composition of brass can be readily modified for specific requirements. The addition of lead, for example, results in a free-cutting alloy admirably adapted for high-speed automatic screw machine operation.

## PHOSPHOR BRONZE USES

*(Continued from Preceding Page, Column 3)*

Bridgeport Brass Company, with its comprehensive manufacturing facilities, is in an excellent position to supply phosphor bronze of the high quality demanded by users of this versatile alloy. Its up-to-the-minute rolling equipment permits the use of larger bars for rolling sheet and strip. When these larger bars are used, the casting is sounder and more homogeneous—an especially important factor in the case of phosphor bronze. Bridgeport will be glad to discuss with prospective users the suitability of phosphor bronze for specific applications.

## NEW DEVELOPMENTS

*This column lists items manufactured or developed by many different sources. Further information on any of them may be obtained by writing Bridgeport Brass Company, which will gladly refer readers to the manufacturer or other source.*

**A turret lathe** of a new design is intended especially for brass work, according to the manufacturer. It has a 16¾-inch swing and is designed for high-speed operation. It is provided with a direct two-speed drive, and is said to feature automatic control of the two spindle speeds and the reverse, which are operated by the movement and indexing of the hexagon turret.

**A brightening agent** is said to be suitable for addition to any standard nickel solution in order to produce a bright, lustrous deposit. It is said to work equally well in conveyors, plating barrels, or steel tanks. Brightness of the deposit is used as an indication of need for periodic additions of the brightener.

**A rack coating** is reported to air-dry much faster than the usual coatings. Dipping speed is about five times as fast, it is said. Coating is of low viscosity, producing thin coatings. According to the manufacturer, no tape or special treatment is needed for applying the coating.

**A spray tank** is especially designed for rinsing racked parts in electroplating. Alternate spray streams circulate both clockwise and counter-clockwise, and are interrupted by straight line streams to produce a multiplicity of spray eddies, it is reported. The maker claims that the method allows water savings ranging from 38 to 86 per cent and time savings up to 65 per cent.

**A solder pot** is designed for dipping small and delicate parts. Inside dimensions of unit are 2¾ by ½ by ⅜ inch deep. Solder capacity is said to be 2¾ ounces.

**A tapping machine** is air-controlled and has a capacity up to ⅜-inch diameter in brass. An automatic valve is said to control the speed with which the tap is fed into the work and reversed. Foot pedal starts and stops the tapping cycle, which is then controlled by the automatic valve.

**A heavy-duty blowpipe** is said to be designed for welding and heating ranges above those which can be handled by ordinary blowpipes. It is said to deliver intense heat to a localized area.

**A new electrode** is said to produce successful welds in non-ferrous metals. It consists of a tube threaded or tapered at bottom to take a standard welding tip, and a light inner tube of flexible copper braid, with provision for water-cooling attachments. It is reported that only the welding tip, the inner tube, and the water-cooling attachments are movable. This arrangement, says the maker, decreases the mass and friction of the moving part, and permits much more rapid movement of the electrode.


## PRODUCTS OF THE BRIDGEPORT BRASS COMPANY

*Executive Offices: BRIDGEPORT, CONN.— Branch Offices and Warehouses in Principal Cities*

**SHEETS, ROLLS, STRIPS**—*Brass, bronze, copper, Duronze,** for stamping, deep drawing, forming and spinning.

**CONDENSER, HEAT EXCHANGER, SUGAR TUBES**—For steam surface condensers, heat exchangers; oil refineries, and process industries.

**PHONO-ELECTRIC* ALLOYS**—High-strength bronze trolley, messenger wire and cable.

**WELDING ROD**—For repairing cast iron and steel, fabricating silicon bronze tanks.

**LEDRITE* ROD**—For making automatic screw machine products.

**COPPER WATER TUBE AND FITTINGS**—For plumbing, heating, underground piping.

**DURONZE ALLOYS**—High-strength silicon bronzes for corrosion-resistant connectors, marine hardware; *hot rolled sheets* for tanks, boilers, heaters, flues, ducts, flashings.

**BRASS, BRONZE, DURONZE WIRE**—For cap and machine screws, wood screws, rivets, bolts, nuts.

**FABRICATING SERVICE DEPT.**—Engineering staff, special equipment for making parts or complete items.

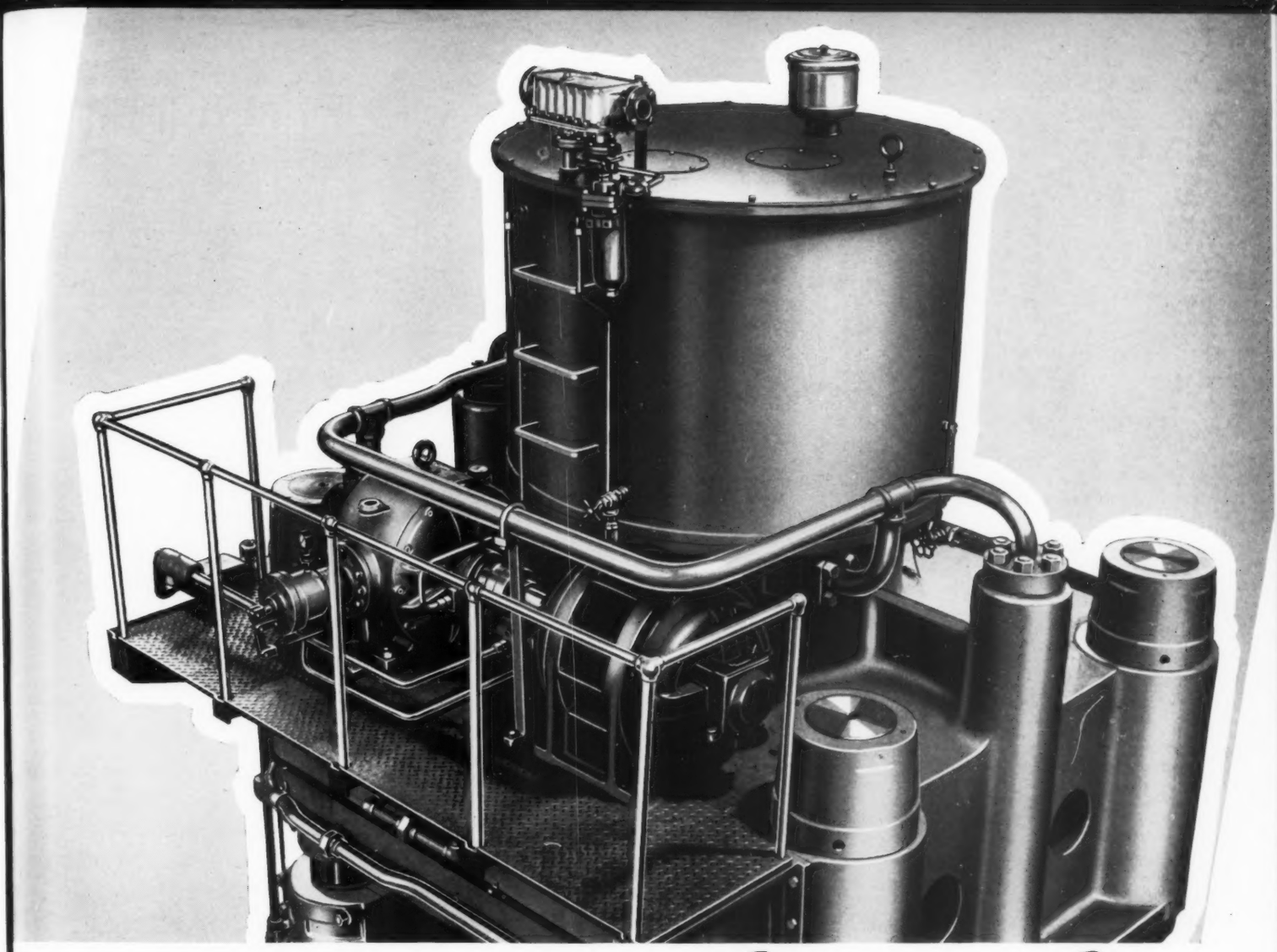
**BRASS AND COPPER PIPE**—"Plumrite"* for plumbing, underground and industrial services.

*Trade-name.

BRASS "Bridgeport" CO.

*Established 1865*

# BRIDGEPORT BRASS



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The operating system must measure up to its responsibility — if the press is to be successful.

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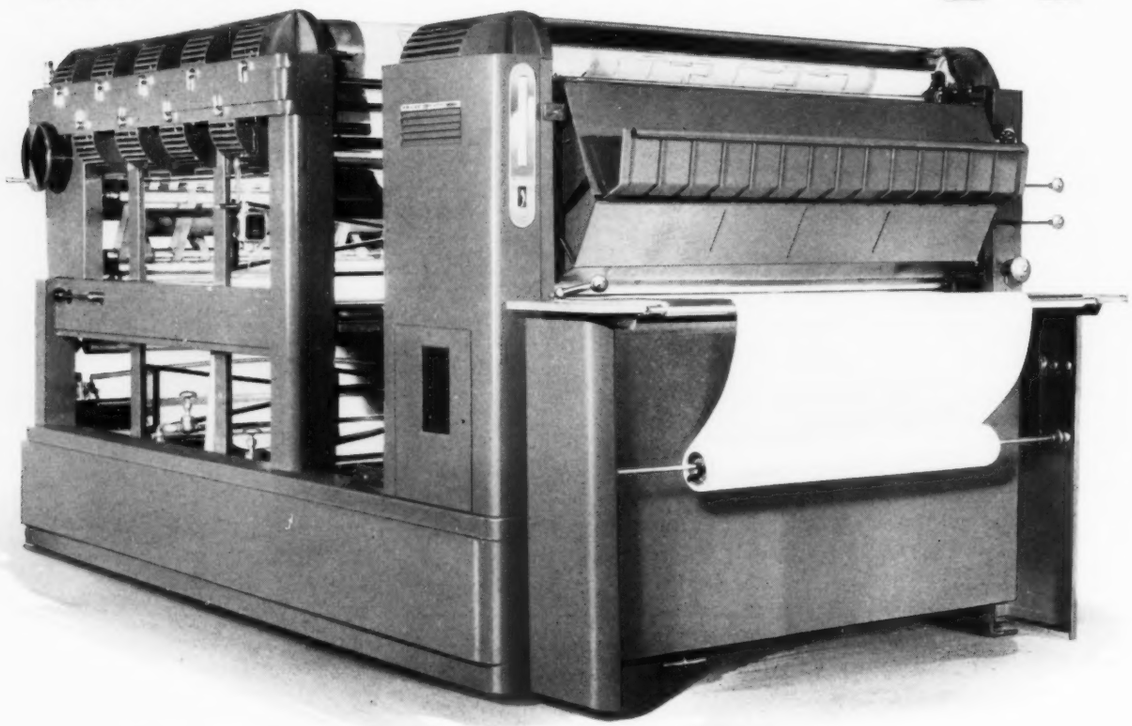

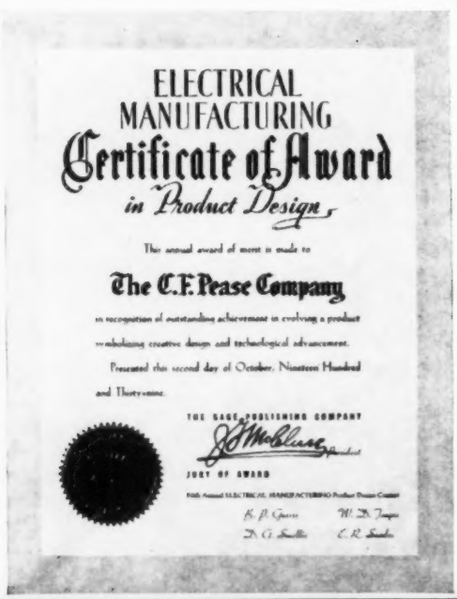

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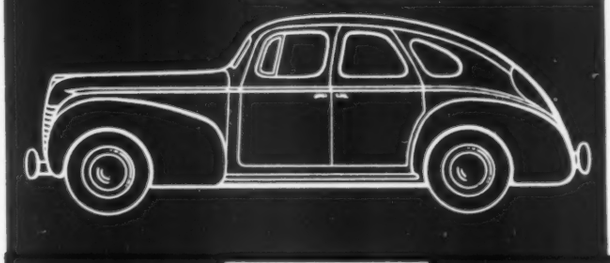
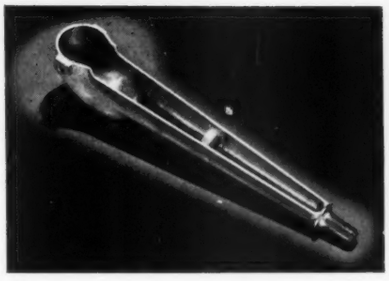
# WHY DOES DETROIT PREFER DIE CASTINGS?

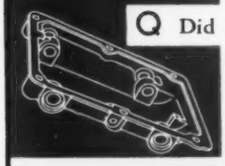


## —A *Quiz*

**Q** Is it possible to solve both appearance and mechanical problems with die castings?



**A** The all-important requirement of this 1940 gear shift lever is strength. As a one-piece ZINC Alloy Die Casting this quality is easily achieved — and smooth appearance couples with low cost to make die casting the ideal method of production.

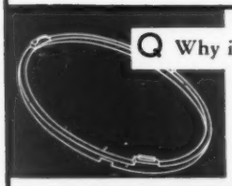


**Q** Did ZINC Alloy Die Castings have any influence on the design of the latest type transmission case?

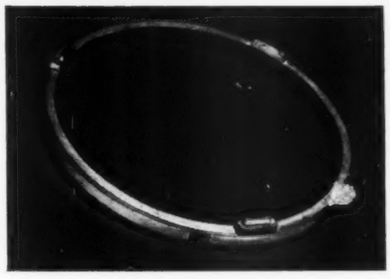
**A** It is highly improbable that the design of this transmission cover could have been carried out by any means other than die casting. With the usual production method, machining costs would be exorbitant.

**Q** Why are horns back as die castings in '40?

**A** This is a question of arithmetic. With quality being more or less equal, the choice of material for horn construction narrows down to price. The illustrated horn part for '40 cars has a ZINC Alloy Die Cast body.



**Q** Why is this seal ring on new sealed beam headlights a ZINC Alloy Die Casting?



**A** Note the 3 integrally cast locating lugs and the knife edge on this die cast ring. The lugs facilitate assembly and the edge is spun to effect sealing. By no other method could this part have been economically produced—in one piece.

**The 1940 automotive die castings reveal a flexibility of design that places this method of metal parts production in a class by itself. And this is only one industry in which ZINC Alloy Die Castings are enjoying wide application. Whether your company produces automobiles or home appliances or dime banks, you should be well versed in this modern metal and method of fabrication. Consult any commercial die caster—or write to The New Jersey Zinc Company, 160 Front Street, New York City.**

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**The Research was done, the Alloys were developed, and most Die Castings are made with**

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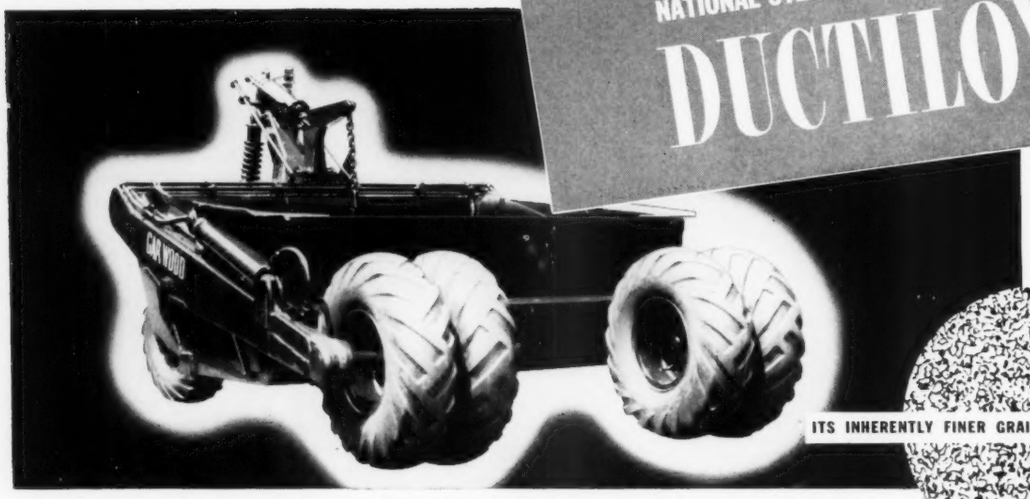
NATIONAL STEEL HIGH TENSILE ALLOY

# DUCTILOY



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DUCTILOY is daily proving its superiority in ductility, cold formability, weldability and in resistance to impact and fatigue. It is proving this superiority not only in a wide variety of applications, but, in many instances, in applications for which other high tensile steels have proved unsuitable.

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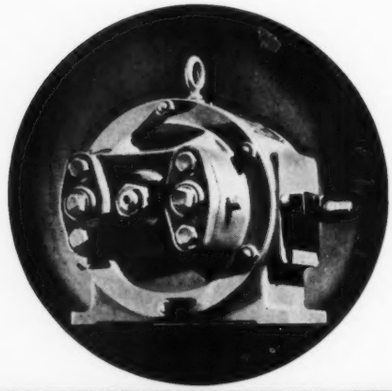

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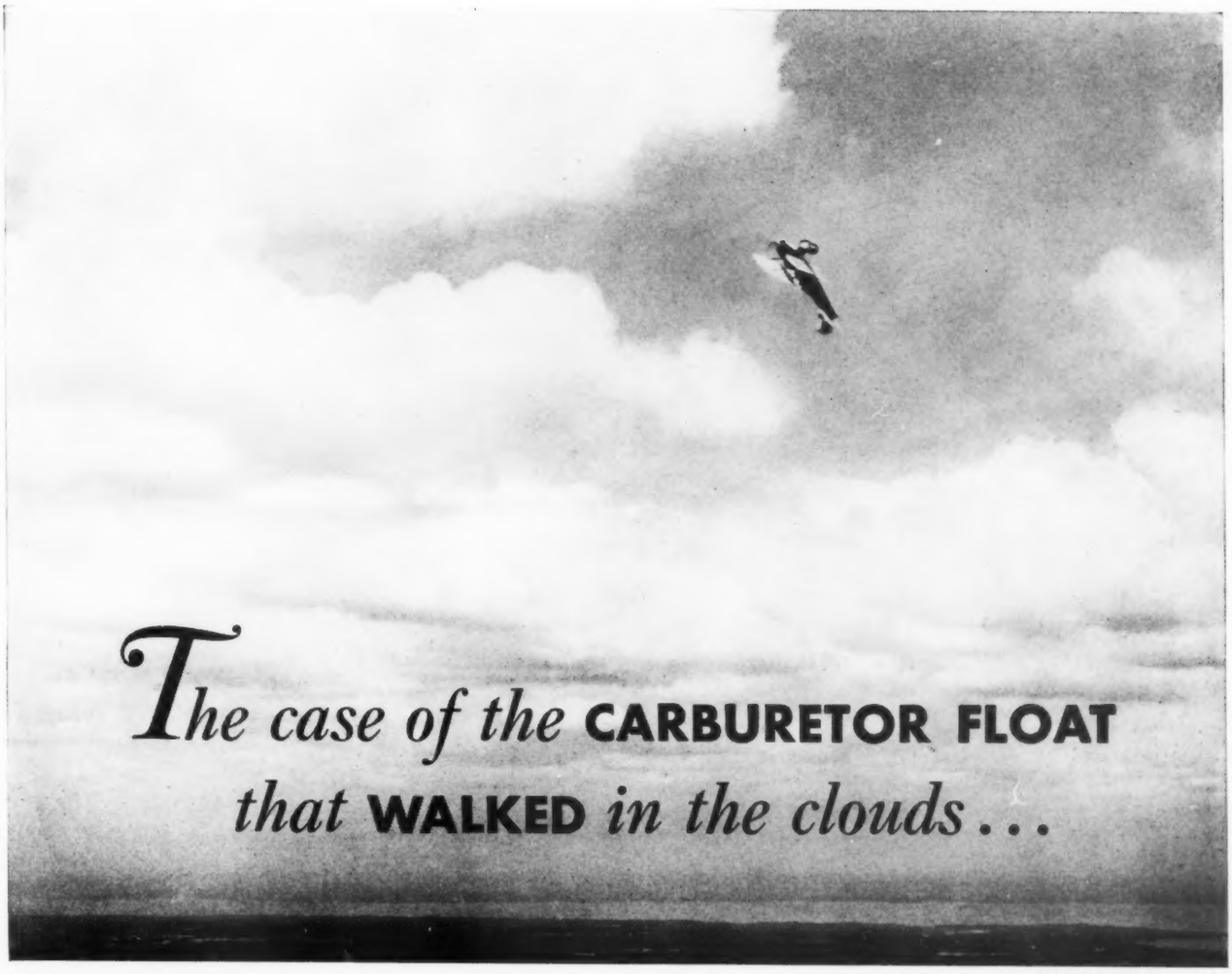

# *The case of the* **CARBURETOR FLOAT** *that* **WALKED** *in the clouds . . .*

*Fairchild Aerial Surveys, Inc.*

## HOW HOLLEY CARBURETOR ANSWERS AIRCRAFT NEED WITH DIAPHRAGMS OF DU PONT NEOPRENE

THIS pilot wasn't exactly nervous. But every time he slow-rolled his ship, the engine would start cutting out. Ten seconds on her back and the engine was dead.

His trouble was simple enough. On any ship the carburetor float valve would "walk away" from its seat in violent stunting.

He knew this "cutting out" was eliminated only by an elaborate two-carburetor system. But he wanted something better.

So a Holley engineer designed for him a carburetor *independent of gravity*. It was a new diaphragm assembly . . . with no floats to "walk away." Variable venturi replaced conventional fixed venturi.

It was a sweet little job . . . but it still had a bug. Where was a strong, flexible diaphragm material resistant to aviation gasoline? Every material failed to meet such exacting requirements . . . until he tried neoprene-impregnated fabric.

Then tests showed the diaphragms were right. He had it . . . the audacious Holley Carburetor, made possible by neoprene's unique resistance to airplane fuels.

The carburetor is now widely used. The neoprene diaphragms are *delivering* . . . in day in, day out contact with aviation gasoline.

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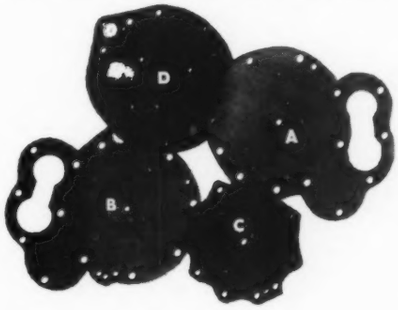


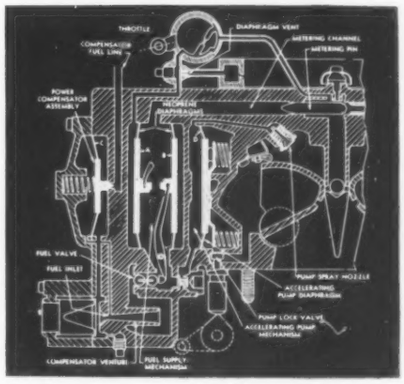


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**76 Pieces to handle**
•
**115 Machine Operations**

## ... and the finished wheel is Better!

Here is just one example of the many thousands in which Steel Castings have saved money.

A manufacturer of artillery wheels for baggage trucks working with other materials, formerly needed 77 pieces for each wheel, with 119 separate machine operations required.

But when Cast Steel was adopted, there was only *one* part to handle, and the machining operations were cut to *four*. No assembly cost *at all*.

And the finished wheel is actually stronger and longer-lived.

Savings like that are the kind that increase profits and open up new markets, by making lower costs possible — for any product.

How about *your* product? Your own foundry will gladly work with you. Steel Founders' Society, 920 Midland Bldg., Cleveland, will advise you — without obligation. Let's get together — for a better product at lower cost.

**IMPROVE YOUR PRODUCT WITH**

# STEEL CASTINGS

*Again...*

# IT'S PLASTICS BY DURITE

For the attractive RCA table type radio cabinet featured.* This giant of portables demonstrates the long flow characteristics of DURITE, its rugged strength, minimum weight, and smooth durable surface finish. ▪ ▪ Radio manufacturers, ever alert in creating new markets, increase the size of DURITE molded portable radio cases with confidence in the splendid service they will render. ▪ ▪ Give your product the benefits of DURITE. Write to Durite Plastics, the exclusive producers of phenol-furfural resins.

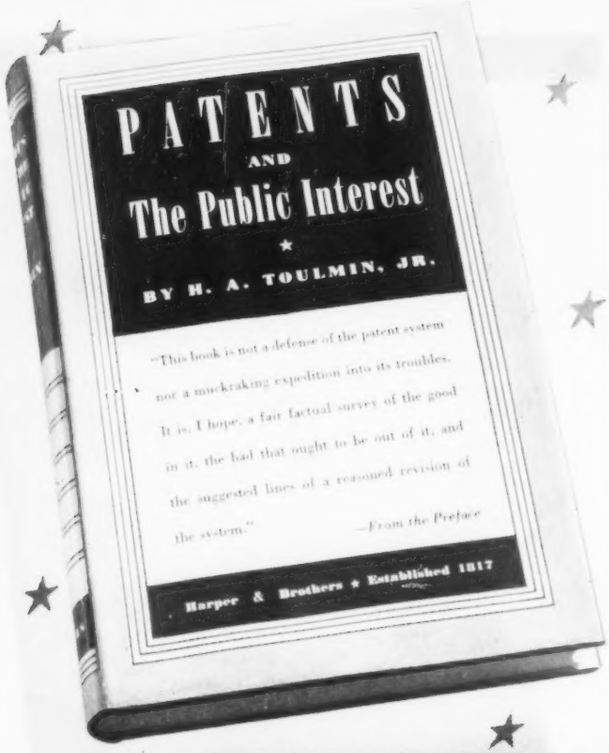
## DURITE PLASTICS

REG. U. S. PAT. OFF.

FRANKFORD STATION P. O. PHILADELPHIA, PA.

**Molded by General Industries, Elyria, Ohio*

# BUSINESS SPEAKS!


PATENTS
AND
The Public Interest
BY H. A. TOULMIN, JR.
"This book is not a defense of the patent system nor a muckraking expedition into its troubles. It is, I hope, a fair factual survey of the good in it, the bad that ought to be out of it, and the suggested lines of a reasoned revision of the system."
—From the Preface
Harper & Brothers • Established 1817

## . . . in a CHALLENGING, FIGHTING BOOK!

**By H. A. TOULMIN, JR.**

Business and the public alike have a *partnership* interest in the United States patent system. Here is a liberal and outspoken examination of the system—its actual workings and effects—by an eminent corporation and patent lawyer. What is the truth about charges concerning patent pools and illegal monopolies, suppression of patents, displacement of labor, and the throttling of research by patents? Are *your* democratic rights under the patent system now being threatened? Be informed. Read this timely book. Of particular interest and importance to corporation executives, plant managers, manufacturers, inventors, engineers and industrial research workers. Examine it FREE. Send coupon now.

HARPER & BROTHERS, Dept. P-12
49 E. 33rd St., New York, N. Y.

Please send me for five days' FREE EXAMINATION one copy of *"Patents and the Public Interest."* I agree to remit $2.50 (plus the delivery charges) within five days or to return the book.

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PRE-CISION

# Micro-Weave

ALL-AMERICAN

## TRACING CLOTH

Precision draftsmanship demands a precision product in tracing cloth. Microweave brings a new, all-in-one quality to the engineering and architectural draftsman who wants the best without premium—fine, flawless weave—no feathering of ink after erasure—high transparency for fine detail—maximum strength and minimum bulk.

To experience its practical superiority, send for a generous sample.

*Companion Products: Royal Blue Print Cloth and Photo-Cloth*

**THE HOLLISTON MILLS, INC.**
**NORWOOD, MASSACHUSETTS**
**Boston · New York · Philadelphia · Chicago · St. Louis**

Fresh, clean and smooth—packed in a handy "Dispenser Box" with brackets for attaching to wall or desk, if desired.

# Tracing Paper can be Transparentized with OIL

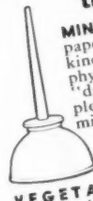
## – but we have found a better way

A radically new transparentizing agent—developed in the K&E laboratories—produced this truly permanent tracing paper! Albanene is made of 100% long fiber pure white rags treated with *Albanite*, a new crystal clear synthetic solid. It is free from oil and wax—physically and chemically inert. Albanene will not oxidize, turn yellow, become brittle or lose transparency with age.

Equally important, Albanene has *all* the working qualities you've always wanted . . . a fine hard "tooth" that takes ink or pencil beautifully and erases with ease . . . a high degree of transparency that makes tracing simple and produces strong sharp blueprints . . . and extra strength to stand up under constant corrections, filing and rough handling. Because Albanene is truly permanent, *it will retain all these characteristics indefinitely!*

Try Albanene yourself, on your own drawing board. Ask your K&E dealer, or write us, for an illustrated brochure and a generous working sample.

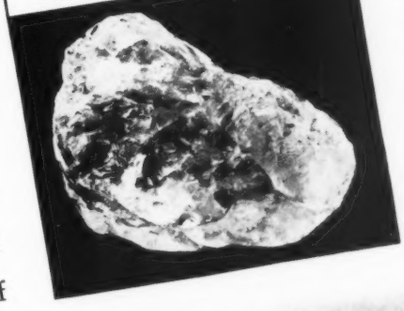
### Most tracing papers are treated with OIL



**MINERAL OIL.** Most tracing papers are treated with some kind of oil. Mineral oil is physically unstable, tends to "drift," never dries completely. Papers treated with mineral oil pick up dust, lose transparency with age.

**VEGETABLE OIL,** chemically unstable, oxidizes easily. Papers treated with vegetable oil become rancid and brittle, turn yellow and opaque with age.

**ALBANITE** is a crystal-clear synthetic solid, free from oil and wax, physically and chemically inert. Because of this new stabilized transparentizing agent, Albanene is unaffected by harsh climates—will not oxidize, turn yellow, become brittle or lose transparency.



EST. 1867

**KEUFFEL & ESSER CO.**

NEW YORK - HOBOKEN, N.J.

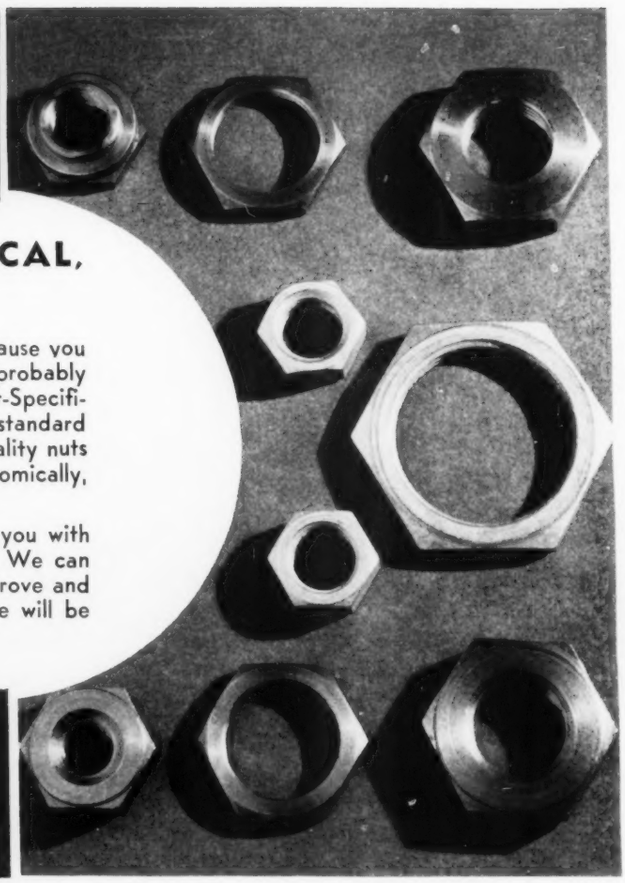
CHICAGO • ST. LOUIS • SAN FRANCISCO • LOS ANGELES • DETROIT • MONTREAL

# K&E Albanene

REG. U. S. PAT. OFF.

THE STABILIZED TRACING PAPER

# When your designs call for special nuts



## Call on WESTFIELD for ECONOMICAL, MADE-TO-ORDER SERVICE

Don't hesitate to use special nuts in your products simply because you are afraid of increasing costs. Consult WESTFIELD and you'll probably find that we can produce nuts Special Custom-Made-to-Your-Specifications for no more than you are now paying for ready-made standard nuts. That's our specialty and we're equipped to produce quality nuts —of steel, stainless steel and alloys—in any quantity, economically, exactly to your requirements.

Then, too, our Engineering Department is prepared to help you with your design of nuts for any applications you have in mind. We can probably save you a lot of time and effort in helping you improve and develop your products. Submit your problems to us and we will be glad to tell you what we can do.

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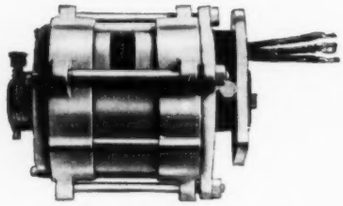
**METAL PRODUCTS CO., INC.**
*Westfield, Mass.*

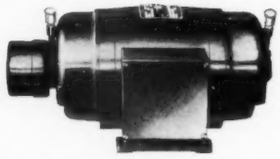
---

# *Don't Spoil The Design of Your Product By Trying to Use Standard Motors!*

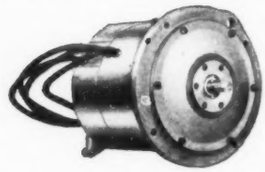
## *Let "ESCO" Experienced Motor Designers Work With You! They Can Solve YOUR Problem!*



*Torque motor for electrically operated valves*



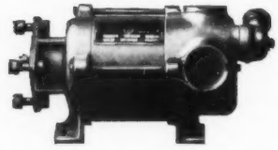
*Rotary converter with automatic speed regulator. Constant frequency A.C. output*



*Driving motor for storage battery operated commercial truck*

These are just examples of our work. We can take care of your own requirements.

*Built-in magnetic disc brakes for hoists, winches and other applications where the load must be held when power is shut off*



*Hoist motor for storage battery operated commercial truck*

Gentlemen: Kindly send me your latest bulletins. I am particularly interested in

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Name ..... Address .....

Company .....

**ELECTRIC SPECIALTY CO.**
**209 SOUTH ST., STAMFORD, CONN.**

# NOT A *Curve* IN A CARLOAD!

**SHELBY TUBING**
*passes*
*rigid specifications for*
*auto parts . . .*

*These swaged tubes will soon be speeding over the highways, as torque tubes in one of America's largest-selling cars. Before shipment, each tube must pass this rigid straightness test. Since these are* SHELBY *Tubes, curves are mighty scarce, for* SHELBY *is as uniform a tube as it is commercially possible to make.*

STRAIGHTNESS is a prime essential in parts of today's autos. Even a slight bend can cause vibration, fatigue, and may ultimately cause failure. No automotive manufacturer wants to risk parts trouble. One way to avoid it is to use the straightest, most uniform tubing obtainable—SHELBY Seamless Tubing.

SHELBY is a precision product, famous among industrial men for its consistent reliability. Its straightness and dimensional accuracy make it easy to meet the strictest tolerances. Its uniform machinability cuts tool wear, speeds production. Its toughness and strength provide added assurance of good performance in vital parts.

For axles (both front and rear), housings, drag links, tie rods, torque tubes, brake cross shafts, steering column tubes, and other vital parts, it pays to use SHELBY Seamless Tubing. Because of the increasing demand for SHELBY for various auto parts, distributors are now carrying larger stocks than ever, ready to give you exactly the kind of service you need.

## NATIONAL TUBE COMPANY

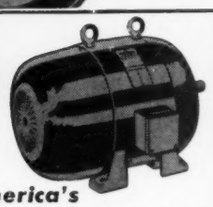
PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

Totally-enclosed, fan-cooled; ½ to 100 H.P.

**HOWELL Type K MOTORS**



***"America's Smartest Design"***

EYE APPEAL — the New Type K Motor has "it"! The all-steel housing lends symmetry of line and curve unmatched by other motors. And this all-steel housing also means a substantial reduction in weight — greater compactness in overall dimensions.

## *Give Your Equipment This Extra Selling Advantage . . .*

Much is gained by driving your equipment with the new HOWELL Type K Motors.

**First, Improved Appearance!** Here are motors so perfectly STREAMLINED as to harmonize with the most modern concepts in machine design. No longer need the motor be the "ugly duckling" of your complete assembly.

**Second, Improved Performance!** For over 13 years Type K Motors (original design) have given phenomenal service on thousands of jobs. And this New Type K is even better — BETTER both electrically and mechanically.

**Use HOWELL Type Ks to help win many new friends for your products!**

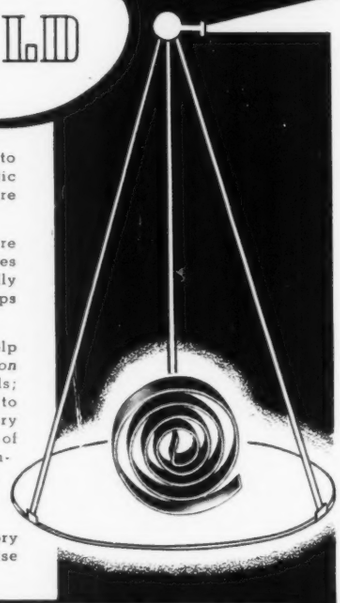
***Would you like Complete Data?***

These totally-enclosed, fan-cooled motors (dust, fume and moisture-proof) are built in all NEMA frame sizes and larger — single and multi-speed. A drive development too IMPORTANT for you to overlook — write today for Bulletin K giving full details!

HOWELL MOTORS — Make Good on Hard Jobs

**HOWELL ELECTRIC MOTORS COMPANY**
HOWELL, MICHIGAN
*Representatives In All Principal Cities*

***Worth Its Weight IN GOLD***



● In the right application to your product Dole Thermostatic Bi-Metal may well prove more valuable than gold.

The low cost of this temperature sensitive metal frequently comes as a pleasant surprise, especially considering how greatly it steps up operating efficiency.

Dole engineers are eager to help you work out the *right application* — strips, sheets, coils, or spirals; parts or sub-assemblies, made to detailed specifications—in every instance an interesting curve of response with the required temperature range, plus an immunity to fatigue proved by many tests.

Write us briefly or the whole story of your requirements. We promise immediate cooperation.

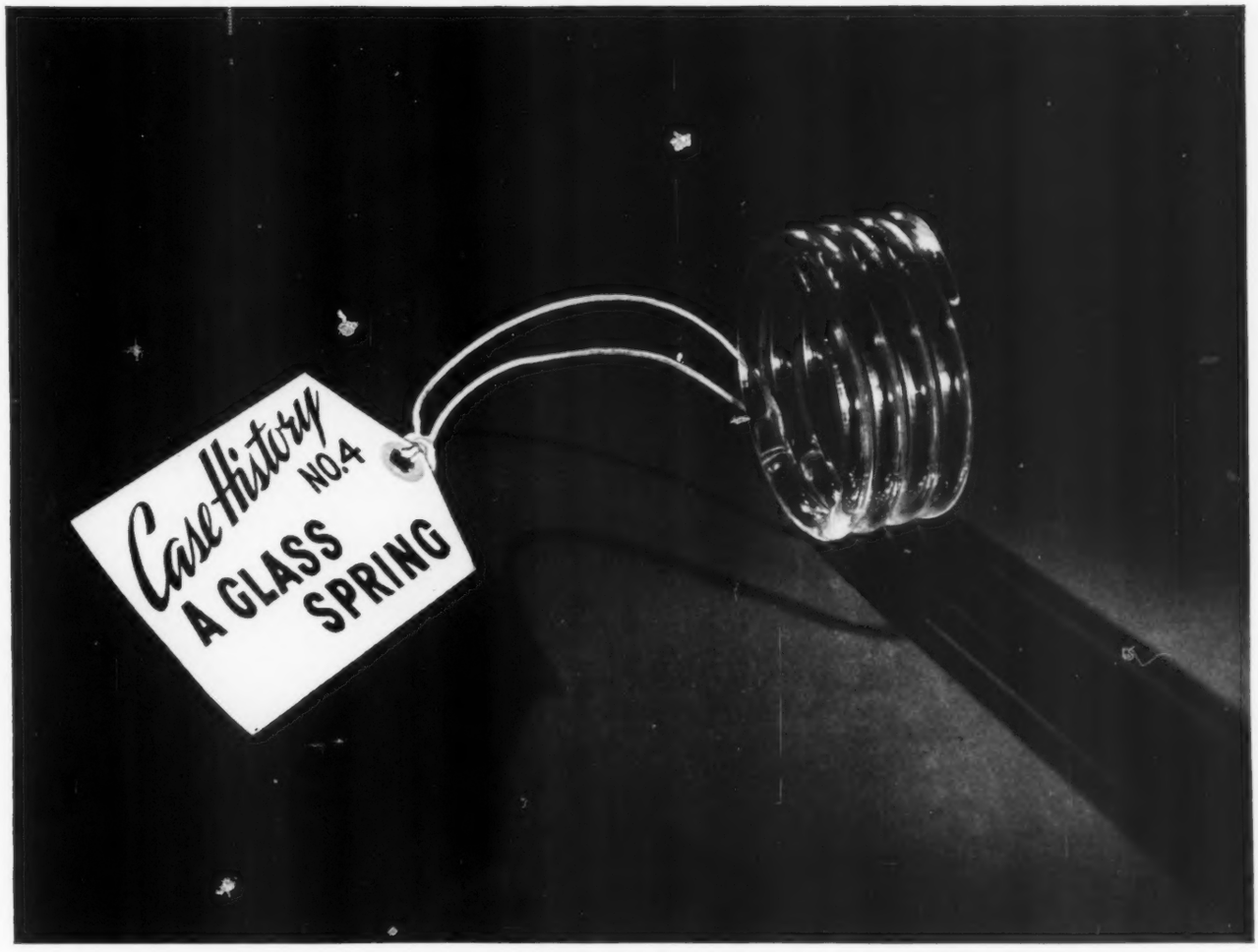
**DOLE THERMO-STATIC BI-METAL**
THE DOLE VALVE COMPANY, 1901-1941 Carroll Ave., Chicago, Ill.
Offices: Detroit and Albany, N. Y.

***when springs get in your hair***

Let the Dunbar "Baldies" come to the rescue - - -

You save time . . often money . . by delegating the design and manufacture of your springs to Dunbar specialists. Ninety-four years spent solely in the making of all sorts of springs.

**DUNBAR BROS. CO.**
DIVISION OF ASSOCIATED SPRING CORPORATION
BRISTOL · CONNECTICUT
*Quality Springs since 1845*




# TO SOLVE A PROBLEM IN CORROSION

*If your specifications call for a material having any or all of the following qualities, consider well "PYREX" brand Industrial Glass.*

High Light Transmission
Resistance to Corrosion
Chemical Stability
Resistance to Thermal Shock
Mechanical Strength
Hard, Smooth Surface
Low Expansion Coefficient
Transparency
Adaptability
High Dielectric Strength
Low Dielectric Loss

THIS spring, made to definite specifications, demonstrates the many possibilities of "PYREX" brand Glass as a material which can be used to improve your present product —or as the basis of an entirely new design.

"PYREX" brand Industrial Glass asks no odds of any corrosion problem. That is why, when a spring that would resist chemical attack was needed, Corning made it of "PYREX" brand Glass.

Don't neglect "PYREX" brand Glass as a solution to your material problem. Investigate its unique combination of characteristics thoroughly. Corning Engineers will gladly cooperate with you in adapting "PYREX" brand Glass to the solution of your particular problems.

T.M. REG. PYREX U.S. PAT. OFF.

*"PYREX" is a registered trade-mark and indicates manufacture by Corning Glass Works*

Pyrex INDUSTRIAL GLASS
BRAND CORNING GLASS WORKS, CORNING, N.Y.

**Visit the Glass Center at the 1939 New York World's Fair**

## What your distributors will say, if you . .

Since your product began coming through with CHROMALOX UNITS as the heating element, we find increasing customer acceptance, and we practically never have to service a heating unit failure. Please place our order for

## . . give your product

# CHROMALOX
## ELECTRIC HEATING UNITS

Dependability in an electrically heated product is the factor vital to its success. Put this factor into your product, with Chromalox units.

Will these units improve your product? Will they add performance qualities? Will they increase saleability? Check with Wiegand engineers, specialists in electric heat, who have materially aided in improving many electrically heated appliances and products, and may add value to yours.

*Chromalox units are made in types and capacities for all heating applications up to 1000 deg. F. The 64-page Chromalox Book describes them, and how to select and apply them. Mail the coupon with your business letterhead.*

**EDWIN L. WIEGAND COMPANY**
**7535 Thomas Blvd. Pittsburgh, Pa.**

Send me the CHROMALOX BOOK OF ELECTRIC HEAT

Name..... Position.....12

## A New Line . . .

# the 500 Series ROTARY GEARED PUMPS

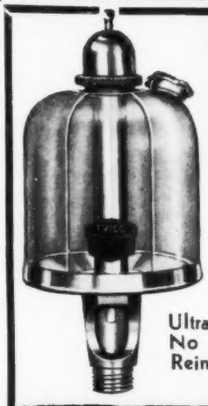
*with* HERRINGBONE GEARS

—Quiet in operation ••• for pressures up to 500 lbs.

Ask for circular

Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

## BROWN & SHARPE PUMPS



# New

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## GRAVITY FEED OILERS

Ultra-modern—Unbreakable — Stream-lined — No gaskets to leak — 50% less weight — Reinforced dual ratchet feed adjustment.

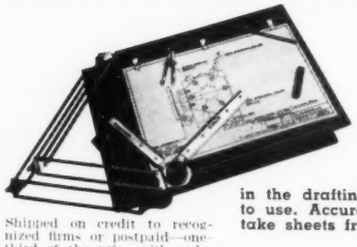
WRITE FOR BULLETIN No. 26

TRICO FUSE MFG. CO. Milwaukee, Wis.

## HANDY • INEXPENSIVE • ACCURATE

# DRAFTO

**PORTABLE DRAFTING MACHINE**



● Here's a time-saving tool for designers and engineers. Use it at home, in the shop, in the drafting room, etc. Complete, ready to use. Accurate and sturdy. Four sizes to take sheets from 9" x 12" up to 15" x 20".

Shipped on credit to recognized firms or postpaid—one-third of the price with order—balance COD.

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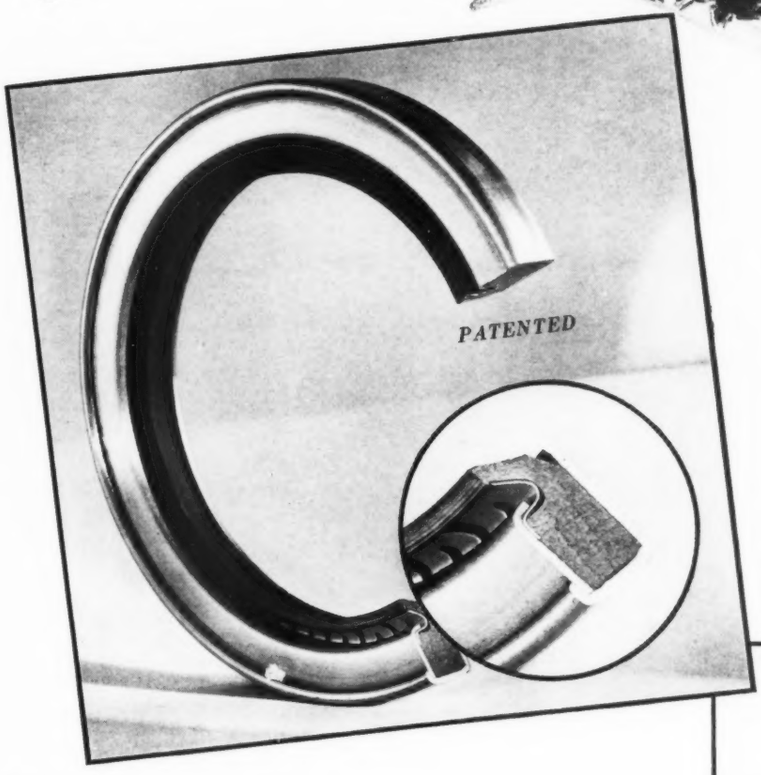
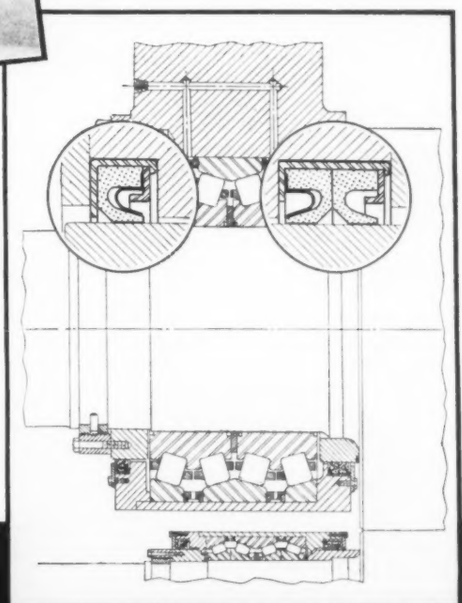
**THE DRAFTO COMPANY — COCHRANTON, PA.**

Chicago Branch 1048 N. Lockwood Ave., Chicago, Ill.

# THEY CAN "TAKE IT"!




## —So Can KLOZURE Oil Seals



DRAGGING a heavy sledge over the ice and snow of the Arctic, a team of "huskies" will cover 60 miles day after day under the most trying conditions. The GARLOCK KLOZURE Oil Seal can "take it," too, under the most trying conditions . . . on "roll necks" in the steel mills, for instance, to mention only one of many successful applications in severe service. The exclusive GARLOCK compound from which the KLOZURE seal is made, is tough and durable . . . resists oil and heat at high or low temperatures. Write for catalog.

THE GARLOCK PACKING COMPANY, PALMYRA, N.Y.
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# GARLOCK

## Our contribution to progressively engineered products

## AlSiMag and Lava

Thru daily contact with problems of corrosion, abrasion, high voltage, ultra high frequency current, and etc., our engineering and research departments have gained an enviable background that will be helpful in solving your ceramic problems. Ask for bulletin No. 39 and its useful ceramic property chart — Address dept. 4-K.

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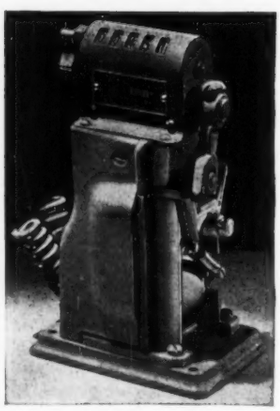
## AMERICAN LAVA CORPORATION

**Chattanooga, Tennessee**



***Durant Electric Productimeter***

## Electric Counting is the Answer

Electric Counting provides the solution of many difficult counting problems on production machines. For instance; when the counting point is inaccessible for reading the counter. When on long machines the counting point is too far removed from the operator for easy checking. When the space for the counter is restricted, wet, or otherwise unsuitable for a mechanical counter. When the action or the pieces produced are too light for mechanical counting.

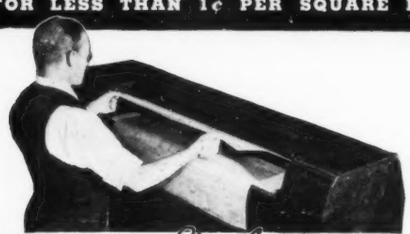
Electric Counting permits mounting a small, simple contactor at the counting point and wiring it to the counter, which is placed where most convenient

**PRODUCTIMETERS** THE SPEEDOMETERS OF INDUSTRY **DURANT MFG. CO.**
**1938 N. Buffum St. Milwaukee, Wis.**

TELL US WHAT YOU WANT TO COUNT

## MAKE YOUR OWN *Blueprints*

**FOR LESS THAN 1¢ PER SQUARE FOOT**



**REMARKABLE NEW *Simplex* BLUEPRINTER CUTS COST, SAVES TIME — NO EXPENSIVE EQUIPMENT. NO EXPERIENCE NECESSARY! · ACT NOW!**

Don't give your money to outside firms for blueprints. With a Simplex Mercury Vapor-Tube Portable Blueprinter you can now make blueprints up to 42" wide (any length) in your own offices at a fraction of regular commercial prices. Makes 250 square feet per hour. Can be used for any of the Special Developing Processes. Requires no carbons or globes. Beautiful black crackle "Weaver" finish. Operates silently. Your office girl can easily operate a Simplex.

**FREE TRIAL**

FREE TRIAL! Don't take our word for the money-saving advantages of a Simplex! For a limited time only we will ship a regulation, complete Simplex Blueprinter on 30 days' free trial. Satisfaction guaranteed or money refunded. Write today for complete facts about this amazing, money-saving offer.

**WICKES BROTHERS • SAGINAW, MICH.**
510 NORTH WATER STREET

# AN *Onion* PEELING PARALLEL

TO get down to the real meat of an onion, you peel off the dead outer skin.

People like to use the homely expression, "slick as a peeled onion" to describe what lies underneath.

There's a striking parallel between a peeled onion and a piece of Micro-Honed steel. Engineers have found after years of experience that there is only one way to get down to the real "meat" of the metal to get a highly finished, mechanically accurate bearing surface: That method is to remove the amorphous, dead metal film left by grinding operations and to further refine the dimensions established by grinding.

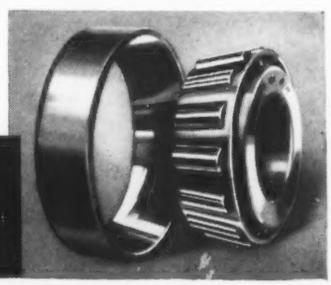
Bower Micro-Honing, an exclusive Bower Process, does this and thus lays bare the hard crystaline metal structure free of surface imperfections—thereby producing a finish that meets every last requirement of the perfect bearing surface.

## THIS "FACE-LIFTING" OPERATION GIVES YOU BOWER MICRO-HONED BEARINGS

1 **ROUGH GROUND**—Photomicrograph—25 diameters—showing amorphous film with roughness of approximately 15 micro-inches (millionths of an inch).

2 **FINISH GROUND**—More but finer scratches—surface finish of approximately 10 micro-inches composed of amorphous metal left by grinding operations—Photomicrograph of 25 diameters.

3 **MICRO-HONED** — 25-diameter photomicrograph showing amorphous metal and grinding marks removed, baring hard surface and smoothness of approximately 3 micro-inches—scratches below surface.



**ASK** for the Bower folder, "How Bower Roller Bearings Undergo a 'Face-Lifting' Operation by Bower Micro-Honing." It makes clear just what the Bower Micro-Honing process is.

BOWER
ROLLER BEARING CO.
Detroit, Michigan

# PUT POWER

*In the Groove*

# LORD

*fractional horsepower*

## COUPLINGS

*for*

- AIR CONDITIONING EQUIPMENT
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- COMPRESSORS
- PUMPS
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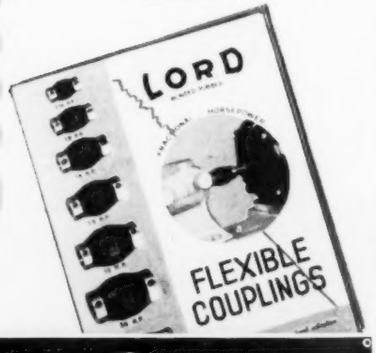
- GENERATORS
- STOKERS
- RECORDERS AND REPRODUCERS, ETC.

do just that by taking up shaft misalignment—angular and parallel—with low bearing loads and negligible power loss. Eliminating fussy alignment speeds assembly and cuts costs. They absorb torsional vibration and stop the passage of motor hum and gear noise along the shaft. Lord Couplings are one piece bonded rubber units—easy to handle and install—pleasing in appearance. Write for bulletin No. 200.

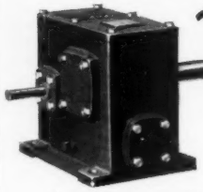
LORD MFG. CO.
ERIE, PA.




BONDED RUBBER JOINTS — LORD BONDED RUBBER — SHEAR TYPE RUBBER MOUNTINGS

NEW YORK CHICAGO BURBANK, CALIF.

# KEEPING THINGS MOVING AT *Macy's*



R. H. MACY & CO. of New York saluted the opening of the New York World's Fair with their entire Broadway storefront of six windows converted into a moving panorama of previous World Fairs.

Designed by Irving Eldredge, display manager of R. H. Macy & Co., these window backgrounds consisted of a group of eight prisms on which the scenes were painted. These trylons turned simultaneously to reveal a second panorama. The third side extends a greeting to each of the forty-eight states.

The Bliss Display Corporation, who built the entire installation, used a large type D3 Ohio gear reducer to turn three mechanisms in each group of windows simultaneously. The three mechanisms connected by a Universal jointed shaft over sixty feet long developed a torque of 1500 inch pounds. So successful has been the appeal of these windows, that they have remained throughout the entire season, an unprecedented event in department store window promotions and proof of the value of ACTION in display.

You'll find the advantages of Ohio Gears and Reducers well suited to your transmission needs also. Write for complete catalog today.

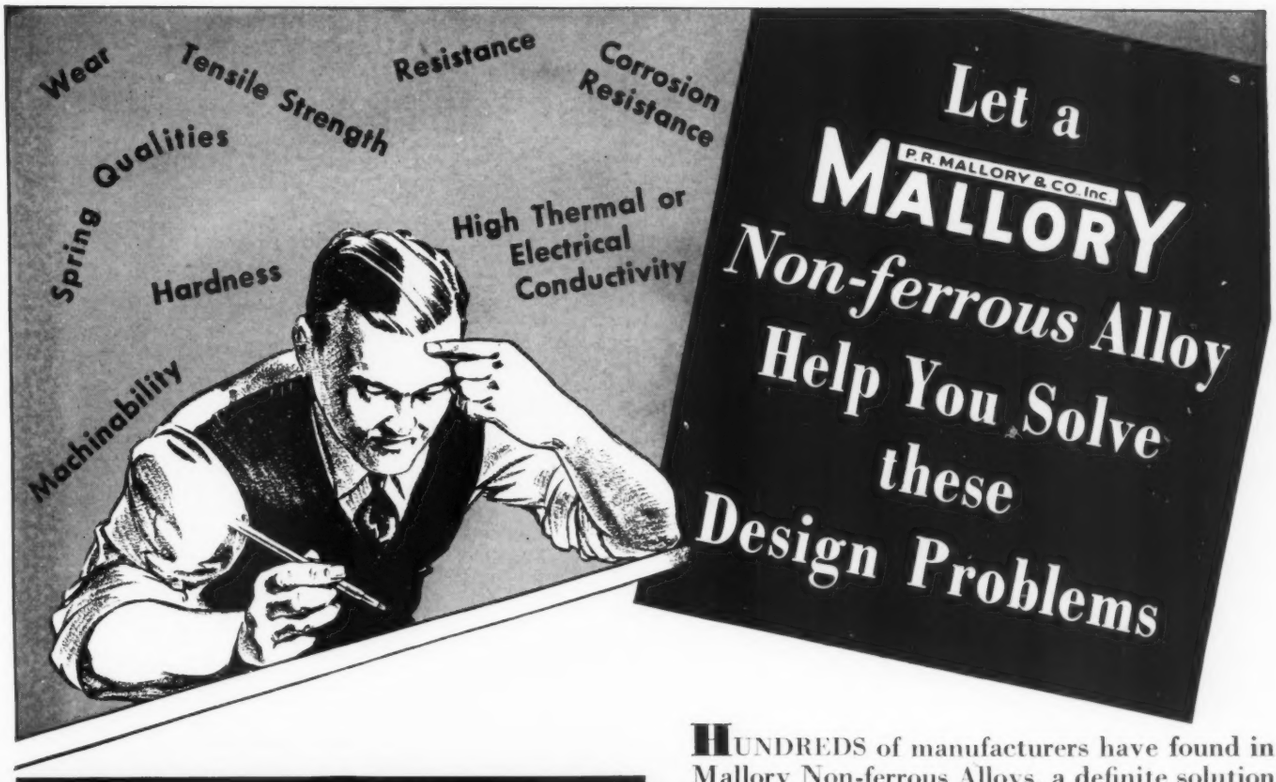
## THE OHIO GEAR CO.

**1325 E. 179th Street • Cleveland, Ohio**

*Representatives*

*NEW YORK CITY, N. Y.
Patron Transmission Co.,
454-456 Grand Street
*LOS ANGELES, CALIF.
J. W. Minder Chain & Gear Co.
927 Santa Fe Avenue
GRAND RAPIDS, MICH.
W. H. Slaughter,
419 Oakdale St., S. E.
*PITTSBURGH, PA.
Standard Machinists & Supply Co.
South 2nd and McKean Street
DETROIT, MICH.
George P. Coulter
322 Curtiss Building
*Stocks carried.*
BUFFALO, N. Y.
F. E. Allen, Inc., 2665 Main St.
*KANSAS CITY, MO.
Kansas City Rubber & Belting Co.
712 Delaware Street
*SAN FRANCISCO, CALIF.
Adam-Hill Co.
244-246 Ninth St.
NEW ENGLAND George G. Pragst
260 Esten Ave., Pawtucket, R. I.
LOUISVILLE, KY.
Alfred Halliday, 330 Starks Bldg.
*INDIANAPOLIS, IND.
A. R. Young
518 North Delaware Street
ST. LOUIS, MO.
St. Louis Tool Co.,
2319 N. Ninth Street

# OHIO GEARS




# Let a MALLORY Non-ferrous Alloy Help You Solve these Design Problems

P.R. MALLORY & CO. Inc.

HUNDREDS of manufacturers have found in Mallory Non-ferrous Alloys, a definite solution of their design and functional problems. Mallory 3, 22, 53, 73, 100, 333 Metals and Elkon Bronze, offer individually or in combination the very properties most frequently sought in non-ferrous metals.

Electrical conductivity, thermal conductivity, high tensile strength, hardness, high yield point, fatigue resistance, corrosion resistance, non-magnetic properties, machinability, resistance to abrasion, resistance to arcing, toughness, ductility, weldability and hot or cold workability. All of these are the desirable qualities which may be found combined in one or the other Mallory Alloys.

Mallory's metallurgists are available without obligation at all times. They will gladly help you in selecting the one alloy best suited to your physical and electrical needs.

Mallory also makes electrical contacts for every service. Years of research on all contact materials qualifies Mallory to impartially recommend the correct contact for any electrical or mechanical condition.

**P. R. MALLORY & CO., Inc., Indianapolis, Indiana**
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MALLORY

**NON-FERROUS ALLOYS and ELECTRICAL CONTACTS**

# RELAYS
## *by GUARDIAN*
## Complete Control Assemblies
### *for Machine and Appliance Manufacturers and Engineers*

★ Bring your control problems to Guardian Electric.

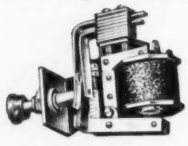
Our experience gained through the design, development and production of thousands of electrical controls—from simple small relays, to intricate combinations—can turn your "headaches" into quick correct answers.

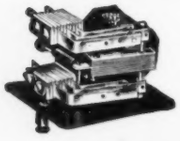
**Small—Compact—Inexpensive**

- *Stepping Switches* • *Solenoids* • *A-C Relays*
- *Time Delay Relays* • *Thermostats* • *D-C Relays*
- *Remote Liquid Level Gauging* • *Impulse Timing*

Anything from a simple contact switch to a complex stepping relay, can be compactly designed, completely fabricated and tested at Guardian . . . delivered ready for mounting in your machine.

**ANY QUANTITY—AS YOU WANT THEM—**
***When* YOU WANT THEM**





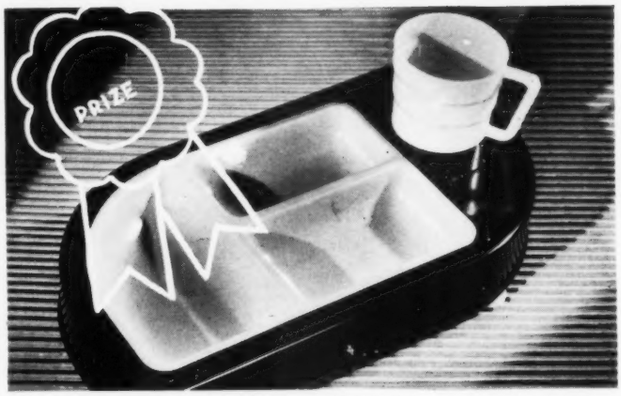
Consultation and suggestions given without cost. Let Guardian engineers work with you . . . for you. Get high-speed deliveries of low-cost controls. Write. Wire. Phone. Ask us to make specific recommendations.

*Send for Catalog "P" Today!*

**GUARDIAN ELECTRIC**
1629 W. Walnut St. Chicago • Illinois



# WE'RE PROUD OF OUR PRIZES
# BUT YOU'RE THE REAL WINNER

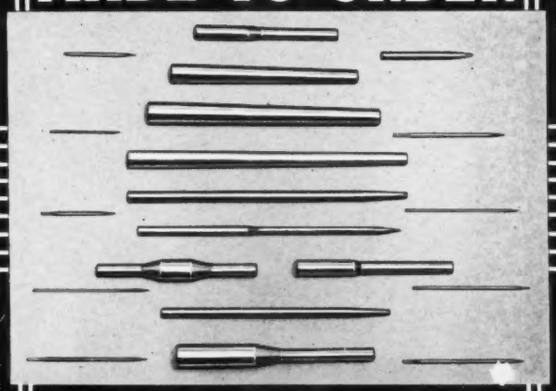



Auburn's two top award winners in Modern Plastics competition—Lockwood Products "Baby's Dyner" and Bausch & Lomb's Balar (3X Binocular) may differ from any other product you might design—but the molding experience, care and skill that made them prize winners can be applied with equal profit to any product. Auburn's standards of quality, workmanship and precision, the result of more than 60 years experience, helps to make every molded plastic product a profit-winner.

MOLDED PLASTICS DIVISION OF
**AUBURN BUTTON WORKS, Inc.**
AUBURN, N. Y.—New York, Chicago, Detroit, Cleveland, Syracuse, Boston



# MADE TO ORDER



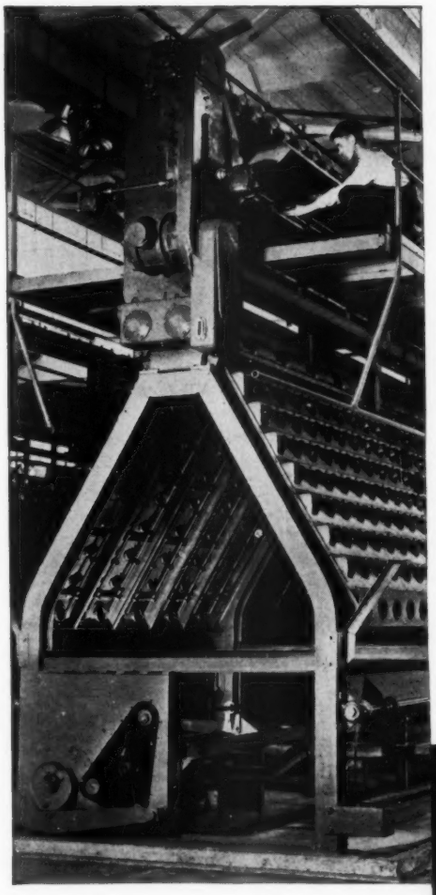
Tubes, Rods, Wire reduced by rotary swaging to your specifications by the pioneer rotary swaging machine builder.

Cuts show various tubes reduced, tapered and closed on end by swaging. Solid work up to 5/8" diameter and medium wall tubing up to 2 1/2" O. D. can be handled.

You benefit from our nearly seventy years' rotary swaging experience.

*The Torrington Company*
SPECIALTY DEP'T.
*Torrington, Conn., U.S.A.*

# All-Welded, Rolled Steel Construction Makes *Miracle Machine* Possible!



*Set-up of the all-welded structural frames for the continuous spinning process machine units—operator's walkway at the process panel level not yet installed, but its supporting brackets are in place. Each unit has an individual motor drive and is composed of 5 intermediate A-frames, one end-drive A-frame with machinery box, 10 process panels, spin frames, spin transmission beams, machinery brackets and various other miscellaneous structural parts.*

*Here's the heart of the newest, most revolutionary production cycle the viscose rayon industry has seen in years. A close-up view of the stepped process panel showing pressed steel cups welded to the inclined skin plate. These cups, counterbored to a tolerance of .001 inch diametrically and held to a close vertical alignment and parallelism, act as retainers for flanged bearings supporting the process reels. Accuracy, rigidity and perfect alignment of the hundreds of moving parts on the panel were obtained through an unusual job of jig welding.*

***Sets new standards of precision . . . at approximately half the cost of previous methods of construction***

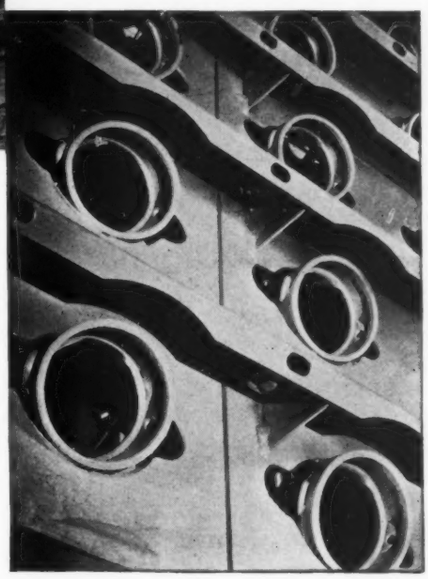
THEY said it couldn't be done. But here it is! The world's first commercial installation for the continuous spinning, processing, drying and twisting of viscose rayon yarn in one machine. 96 of these machines were installed in the new Painesville, Ohio, Plant of the Industrial Rayon Corporation. They will eliminate handling and interruptions, and produce a higher quality, uniform yarn more economically than ever before.

And all-welded construction with U·S·S Rolled Steel made it economically possible! Rolled steel construction effected a large reduction in weight . . . and a clean-cut structure devoid of complicating details and multiplicity of small parts.

The structural steel frames for these machines were fabricated by American Bridge Company. Each of the 96 units is 10 ft. 1 in. wide, 45 ft. 1 in. long and about 19 ft. high. Not merely the quantity involved, but the extreme accuracy required to assure perfect alignment needed constituted a problem which was economically solved by a resourceful, efficient combination of welding and U·S·S rolled shapes.

This revolutionary use of rolled steel construction opens a new realm of possibility for the fabrication and design of industrial equipment. From the experience gained on this contract, it is believed that many types of machine frames and supports, hitherto thought impractical to fabricate by welding, may now be undertaken with confidence.

We offer special steels in widest range. And our experience in putting these steels to work is yours for the asking. Investigate the economies, the added life, the strength, and speed of fabrication that rolled steels can give to equipment you fabricate.



**Here are a few of the variety of special steels with special properties to overcome destructive forces in your rolled steel construction:**

**U·S·S HIGH TENSILE STEELS**
*to carry high unit stresses and to reduce weight to a minimum at low cost.*

**U·S·S ABRASION RESISTING STEELS**
*to reduce wear and cut replacements.*

**U·S·S CARILLOY ALLOY STEELS**
*to carry tremendous bearing pressures.*

**U·S·S HEAT RESISTING STEELS**
*to endure high temperatures that spell disaster to other metals.*

**U·S·S STAINLESS STEELS**
*to resist corrosive environments, to assure long life. Special analyses can be welded with no loss in corrosion resistance.*

CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*
United States Steel Products Company, New York, *Export Distributors*

**UNITED STATES STEEL**

**Here's a safety insurance policy for the machines you design—Equip with**

# UNBRAKO

**SELF-LOCKING HOLLOW SET SCREWS with the Knurled Points**

Fig. 1645 Pat's. Pend.

Fig. 1646 Pat's. Pend.

"UNBRAKO" SQUARE HEAD SELF-LOCKING SET SCREWS offer this same unfailing protection combined with high strength and accuracy. We'd be glad to send you a sample so you can see for yourself.

Breakdowns, caused by ordinary set screws shaking loose, can be prevented very simply by using "Unbrako" Self-Lockers. And by so doing you reduce the maintenance headache too. Here's why:

The knurling around the points of "Unbrako" Self-Locking Hollow Set Screws holds them fast when tightened up in the normal way—and no amount of vibration can rattle them loose. Even so, removal for adjustment is easy and the screws can be re-used over and over again.

**STANDARD PRESSED STEEL CO.**

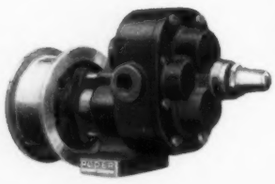
BRANCHES BOSTON DETROIT INDIANAPOLIS — JENKINTOWN, PENNA. Box 545 — BRANCHES CHICAGO ST. LOUIS SAN FRANCISCO

## *They Get in there and Pitch*

When you apply a Roper Coolant Pump to a machine tool you can depend upon it to get in there and pitch. It will throw a heavy stream, free from pulsation, with ample force to reach the deepest cuts and bores.

Roper Coolant Pumps are guaranteed not to lose prime and to work against high or low pressures.

Simple, sturdy construction . . . only 2 moving parts . . . long dependable service with the highest degree of efficiency. Write for Bulletin R4PE.



**ROPER**

*Coolant*

**PUMPS**

**GEO. D. ROPER CORP., ROCKFORD, ILL.**



**HEADQUARTERS FOR ELECTRICAL CONTROL DEVICES**

- RELAYS
- SOLENOIDS
- STEPPING SWITCHES
- ELECTRIC COUNTERS
- SIGNAL LAMPS
- SWITCHING KEYS
- PLUGS AND JACKS

★ For 50 years, we have specialized in the manufacture and application of these devices. May we apply our experience to your problems? American Automatic Electric Sales Company, 1033 W. Van Buren St., Chicago.

**AUTOMATIC ELECTRIC**

*Makers of Telephone and Signaling Apparatus*
*Electrical Engineers, Designers & Consultants*

# NOW AVAILABLE

## *Complete Motor Protection for Single- and Poly-phase Motors*

### PROTECT YOUR MOTORS FROM BURNOUTS

New additions to the Spencer line of disc-operated motor protectors make it possible for all a. c. motors —single- or poly-phase—to have economical snap-acting inherent protection against overloading or overheating. Amazingly simple and effective, these compact, little protectors contain no complicated or troublesome parts. They are operated by scientifically-calibrated thermostatic discs that provide instant, positive action whenever the motor is in danger. Yet in spite of their snap-action and sensitivity they do not limit safe peak operation of motors.



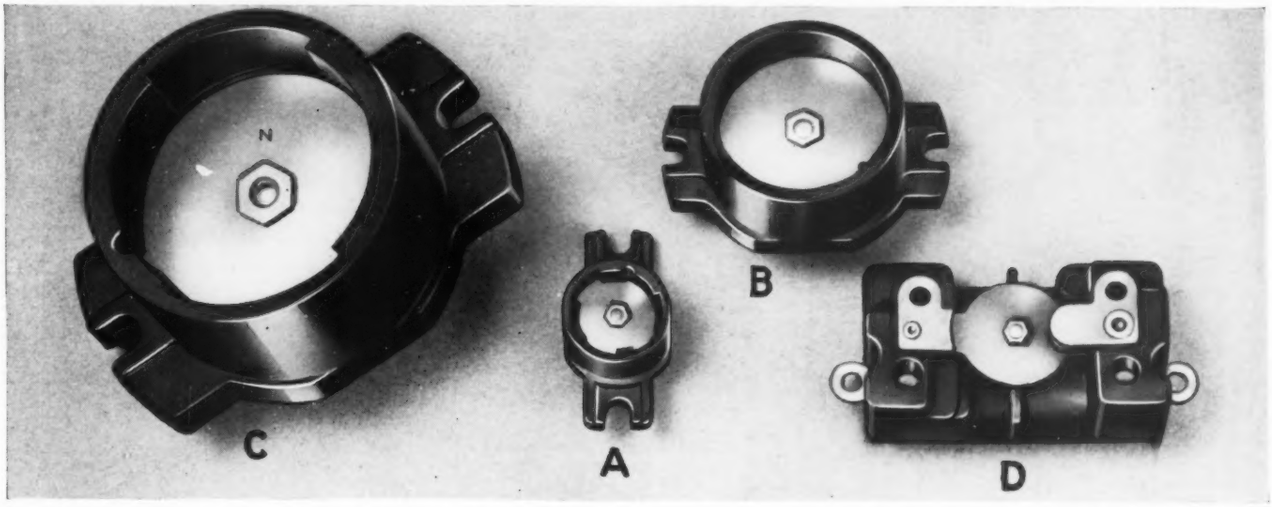
### *Ask Your Motor Supplier for this Protection*

Leading manufacturers of motors are in a position to give you this protection. Ask for it.

### *Direct Protection up Through 3 H.P. Larger Motors Through Contactors*

Especially recommended for unattended motors used in refrigerators, heating and air conditioning apparatus, oil burners, stokers, fans, blowers, electric tools and machines as well as most other electrical appliances.

### HERE ARE SIZES AND APPLICATION RANGES FOR KLIXON PROTECTORS




**A. The New Klixon ½" Protector**
Provides inherent overload and overheat protection for fractional horsepower, single phase motors up to ¼ H. P.
Also used as an inherent temperature control unit on large integral horsepower, poly-phase motors. Mounted directly on the motor windings. Breaks pilot circuit of motor contactor.

**B. The Klixon 1" Protector**
Provides built-in overload and overheat protection for fractional horsepower, single-phase motors up to 1½ H. P. Breaks the load directly. Used successfully in over 1,000,000 fractional horsepower motors.

**C. The New Klixon 1½" Protector**
Provides inherent overheat and overload protection for single- and poly-phase motors up to 3 H.P. On single- and poly-phase motors above 3 H. P.—available for inherent protection against overheating and excessive current (breaking pilot circuit of motor contactor, not the load directly).

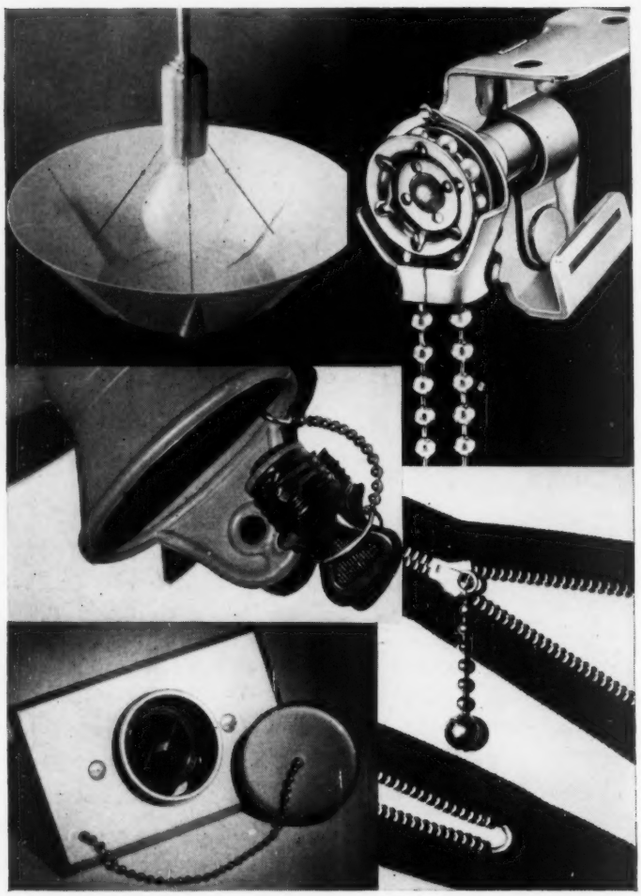
**D. The New Two-Pole Protector**
For certain types of fractional H. P. repulsion-start induction and capacitor motors. Simplified protection on 3-phase motors up through 3 H. P. breaking the line directly.

**Ask your motor supplier to equip your future motors with Klixon Protectors. Eliminate the trouble and cost of motor burnouts.**

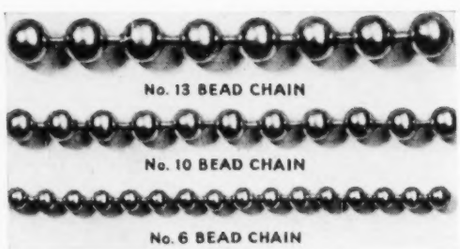
KLIXON
TRADE MARK REG. U.S. PAT. OFF.

**SPENCER THERMOSTAT CO.**
**912 FOREST STREET, ATTLEBORO, MASS.**

# INGENUITY



# BEAD CHAIN*

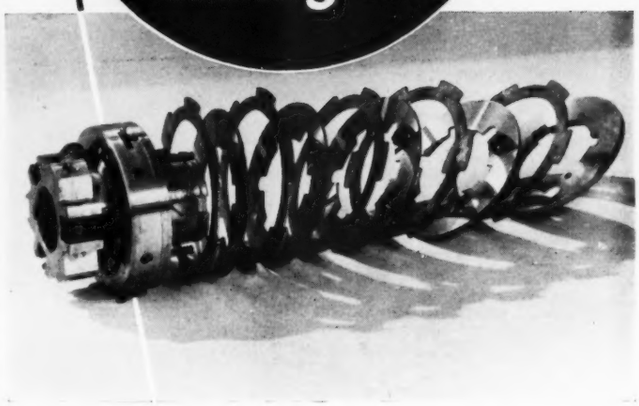



When we know your problem and you know the strength and appearance of non-kinkable BEAD CHAIN* it is more than possible that with your ingenuity and ours, BEAD CHAIN* may be most advantageously used with your product.

BEAD CHAIN
ESTABLISHED 1914
Trade Mark Reg. U.S. Pat. Off.

THE BEAD CHAIN MANUFACTURING CO.
62 MT. GROVE ST. BRIDGEPORT, CONN.
*Reg. U.S. Pat. Off.

# Driven Plates don't cut into the Driving Key

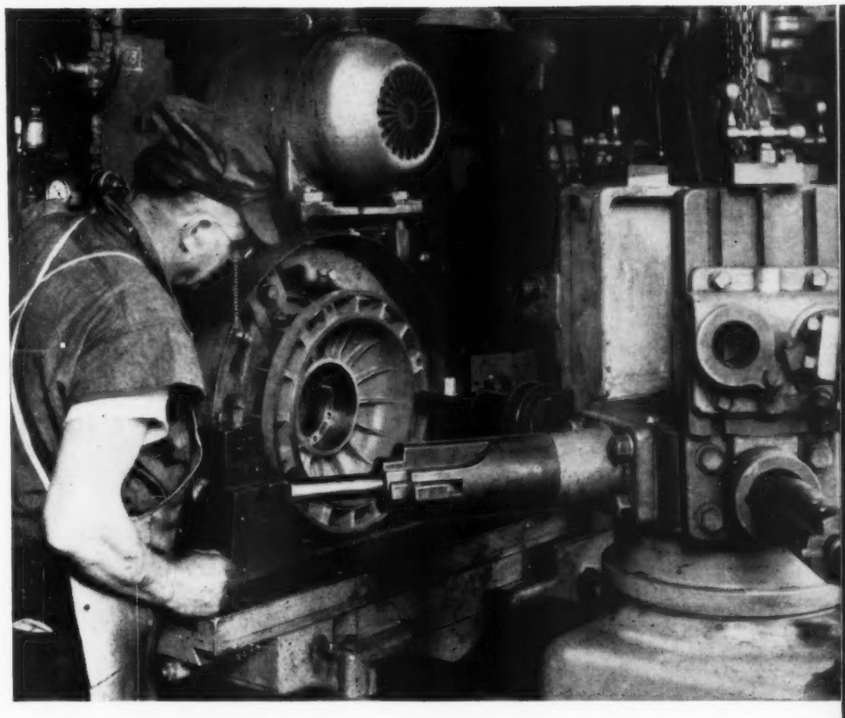


In Twin Disc MT Clutches, both "dry" and "in oil" types, the driven plates are of saw steel, heat treated and ground. They are driven by hardened keys, set in keyways in the clutch hub. ¶ This construction not only provides accurate location of the driving key but prevents the cutting of the driven plates into the driving key. Another detail that assures longer life and better performance of Twin Disc Machine Tool Clutches.

Ask our Engineering Department for detailed description of Twin Disc MT Clutches and find out why so many production men say "Twin Disc Machine Tool Clutches make a good machine better."

TWIN DISC
CLUTCHES

TWIN DISC CLUTCH CO. • 1339 RACINE ST. • RACINE, WIS.



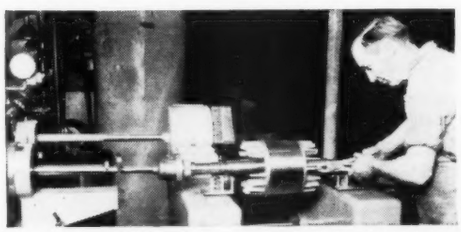
# FRIENDLY RELATIONS

## End frame—ball bearing cartridge —ball bearing

**Accurate machined surface relation between end frame, ball bearing cartridge and ball bearing is accomplished by the common Delco practice of grouping operations. Turning operations on motor end frames are done in one operation, and turning and boring operations on ball bearing cartridges are completed in one setup, as shown here. Delco ball bearing cartridges are machined to the tenth of a thousandth of an inch, to insure the proper fit of a selected bearing.**

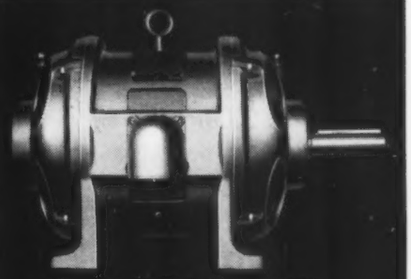
**On sleeve bearing types, the end frame is machined in the same manner, and the oil reservoir is thoroughly cleaned and lacquer-sealed at high pressure. After the babbitt-lined bearing is pressed into place, it is diamond-bored to very close limits, insuring an inside diameter concentric with the register on the end frame.**

**Delco urges prospective motor purchasers to consider what this precision workmanship means to their lasting satisfaction, and to *look within* the motors they specify.**

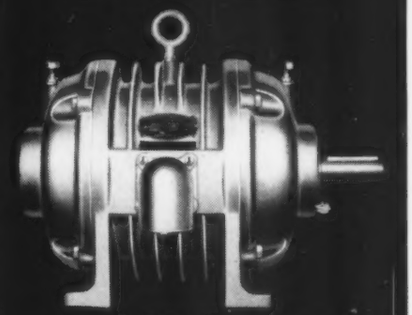


**EVERY DELCO MOTOR IS DYNAMICALLY BALANCED**

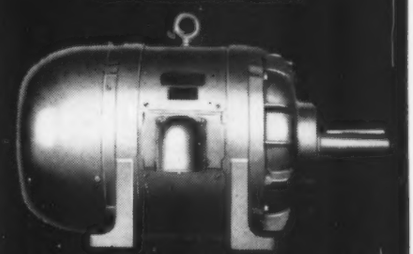
No motor leaves Delco Products that has not been dynamically balanced on a specially-designed balancing machine. Delco balances every motor. Each end of the rotor and shaft is first balanced independently, while the machine indicates exactly how much compensation is required and where it should be applied. After all adjustments have been made, the complete rotating assembly is given a final check. Delco motors assure satisfactory balance.



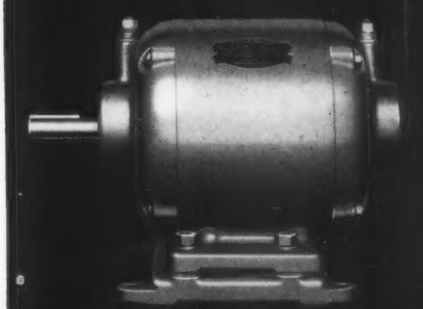
Open Frame, Sleeve or Ball Bearing



Totally Enclosed Ball Bearing



Totally Enclosed Fan-Cooled Ball Bearing



Fractional Horsepower Motor

• • •

Delco industrial AC motors are available in various types, possessing electrical and mechanical characteristics to meet practically every requirement.

Normal starting torque—normal starting current—high starting torque—low starting current—as well as high slip. Each type available in open frame, sleeve or ball bearing—totally enclosed ball bearing—totally enclosed fan-cooled ball bearing—also multi-speed motors. Electrical and mechanical modifications available. Delco motors comply with NEMA standards.

**DELCO MOTORS**

DIVISION OF GENERAL MOTORS CORPORATION

DELCO PRODUCTS · DAYTON, OHIO

*The Results of a Superior Manufacturing Method Patented by Holo-Krome.*

## *the Test of Quality*

Holo-Krome FIBRO FORGED Socket Screws are constantly proving their Quality, inside and out, in the thousands of daily applications of Socket Screw Users.

Each application emphasizes this proven fact—Holo-Krome Quality does give Unfailing Performance.

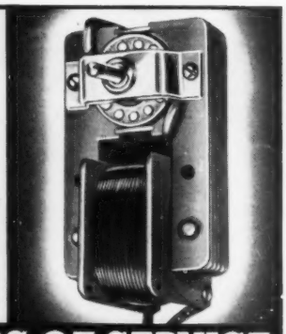
Have you an application where you would like to make use of the Holo-Krome Unfailing Performance? If so, specify Holo-Krome. We guarantee you, too, will have the same result—Unfailing Performance from each and every single screw.

# HOLO-KROME

FIBRO FORGED TRADE HK MARK SOCKET SCREWS

THE HOLO-KROME SCREW CORP. HARTFORD, CONN., U.S.A.

## A BABY POWER PLANT



***BUILT FOR YEARS OF SERVICE***

SCORES OF USES such as driving fans, movie projectors, and other light home appliances; powering toys, motion displays, switches and control systems—these and many other applications have proved the lasting dependability of the Alliance Model MS Motor, illustrated above.

The MS MOTOR is unidirectional, available for either clockwise or counter-clockwise rotation. It may be wound for voltages from 24 to 250 at frequencies of 40, 50, or 60 cycles, with power outputs ranging from 1/250 to 1/800 H.P. consistent with duty cycle requirements. Finest materials and precision manufacturing assure long life and freedom from breakdowns. Exceptionally low priced.

*Write or wire for sample and complete information.*

**ALLIANCE MFG. CO.**

Dept. G ALLIANCE, OHIO

## WITH BUSINESS LOOKING UP

***How About Launching That***

## NEW PRODUCT?

IF it is to contain screw machine parts, for accuracy and uniformity, see that they are Newton parts. Thousands of machines, appliances, and other devices in use today owe much of their smooth performance to their Newton-made cams, slides, nuts, bolts, or other important "little" parts.

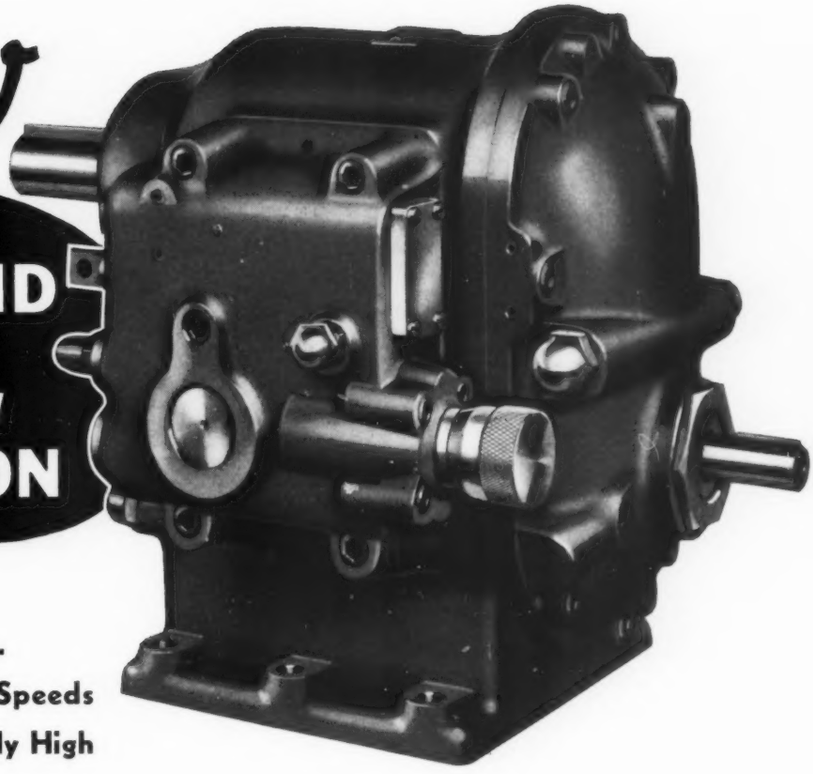
This long experience has taught our force much that should be of value to you in getting what you want, when you want it, and at the price you want! Send along your blue prints for estimate.

**THE NEWTON MFG. CO.**
**9 Riverside Ave., Plainville, Conn.**

**NEWTON**
**SCREW MACHINE PARTS**
**(SEPARATE OR ASSEMBLED)**

# New

## SUNDSTRAND
## *OIL POWER*
## *Variable Speed*
## TRANSMISSION

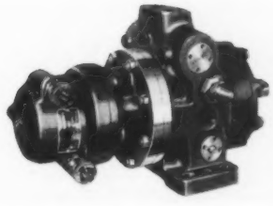


- **Stepless Speed-range, from 10 r.p.m. to 3000 r.p.m.**
- **High Starting Torque at Low Speeds**
- **Overall Efficiency Unusually High**

# For Machine Tools and Many Other Applications

The new Sundstrand Oil Power Variable Speed Transmission has one of our multiple-piston fluid motors mounted above our hydraulic pump of similar design. This makes a small, compact, highly efficient unit that is easily built into machine designs, is simply and flexibly controlled by mechanical, hydraulic or electrical means. In starting, accelerating to maximum speed, stopping, and reversing there is no input power loss. Surface speed of pump- and motor-valves is extremely low, no rotary valves are used, and no valves whatever are required for reversing. Rated at 2 h.p., with infinite adjustment of speeds between 10 r.p.m. and 3000 r.p.m., this Variable Speed Transmission is ideal for speed or feed drives in machine tools or other modern machinery. Investigate.

To engineers, designers and manufacturers of industrial machines, Sundstrand hydraulic equipment presents remarkable possibilities for utilizing the smooth power, instantly responsive control, and flexibility of hydraulic actuation. Besides Variable Speed Transmissions, the Sundstrand line includes Hydraulic Pumps, Fluid Motors and Controls for a wide range of applications. Write, today, for complete information.



Above, PWX Pumping Unit for a constant-speed rapid movement and two variable slower movements. Many other combinations available.

Above, Sundstrand Oil Power Fluid Motors range in speed from 2 r.p.m. to 3600 r.p.m. and in size from 1 h.p. to 40 h.p.

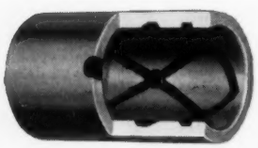
A Division of SUNDSTRAND MACHINE TOOL CO. · ROCKFORD, ILLINOIS, U.S.A.

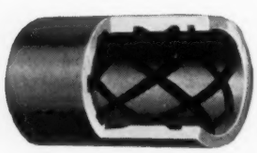
## Sundstrand Pump Division

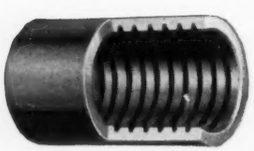
**2556 Eleventh St., Rockford, Illinois, U. S. A.**

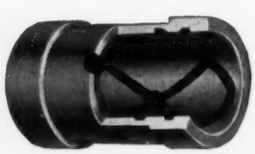
# THESE *Randall* BUSHINGS

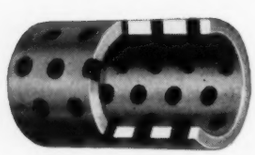
## ASSURE 300% TO 400% LONGER SERVICE

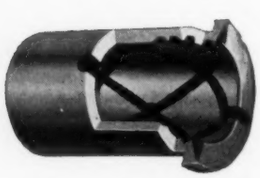












The Randall bushing record is one of long, trouble-free, reliable operation. A third of a century's experience, steady progress and research have made possible the dependable Randall performance.

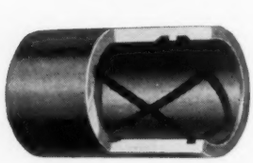
Randall Graphite Bronze Bushings have a low coefficient of friction, and will neither sieze nor score the shaft. The graphite, an exclusive Randall formula, is permanent.

Randall bushings, a few of which are illustrated, are available in any required size or style. They may be reamed, broached, or diamond bored.

Randall also manufactures a complete line of self-aligning, self-lubricating Pillow Blocks of which one style is illustrated.

Whatever your bearing problem, Randall engineers will be glad to assist you with no obligation. Write for complete information and catalog of standard types and sizes.

Randall Universal Pillow Block with Double Reservoir Oil Return. Bearing surface is diamond-bored



*Randall* GRAPHITE PRODUCTS CORP.
Dept. 1212 609 W. Lake St., Chicago, Ill.

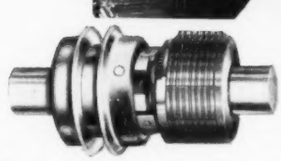
WRITE FOR GENERAL PUMP CATALOG

TUTHILL *Pump Company*
941 EAST 95TH STREET, CHICAGO, ILL.

DEPENDABILITY PROVEN BY HUNDREDS OF THOUSANDS IN THE FIELD



A Baker Truck *with* Pullmore Clutch



# Pullmore Clutches

## Provide Powerful Positive Control

In the grueling service of industrial trucking, Pullmore Clutches provide a dependable and economical control of power transmission for rapid pick-up, heavy loads and frequent operation. Pullmore Multiple-Disc Clutches are simple, compact, easy to install; are available in single or double types, for operation in oil or dry, in capacities from 1 h.p. to 75 h.p. at 500 r.p.m. Write for the Pullmore Blue Book showing applications, features and data.

Also available are Rockford Spring-Loaded Clutches and Rockford Over-Center Clutches for a wide variety of industrial uses. Investigate.

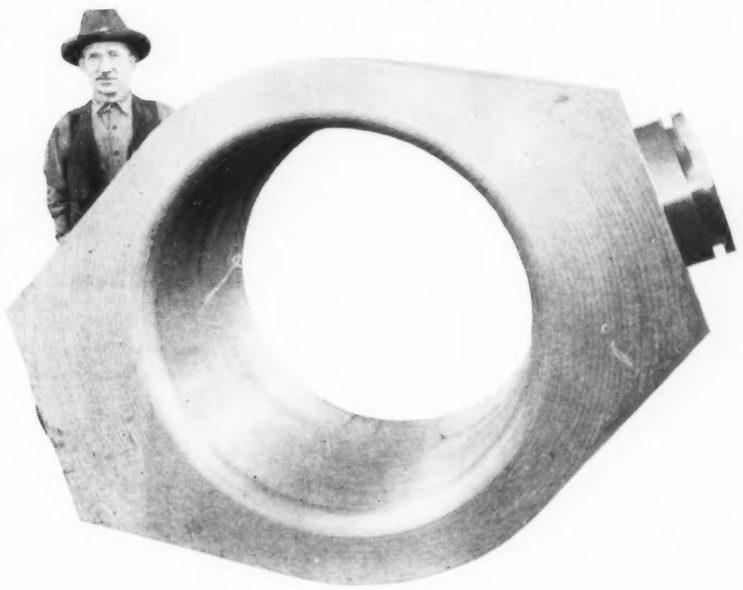
**ROCKFORD DRILLING MACHINE DIVISION**
*Borg-Warner Corporation,* 209 Catherine Street, Rockford, Illinois
Sold by MORSE CHAIN CO., Ithaca, N. Y. With Offices in Principal Cities

# UNUSUAL *forgings . . .*

**Forgings of unusual size or character are nothing new for "Standard." Such work constitutes a regular and well-established part of the business.**

**Standard Steel Works Company, Phila.**
**Subsidiary of The Baldwin Locomotive Works**

Forged Carbon Steel Lifting Swivel
Weight 10,400 lb.



Forged Carbon Steel Roll—Length 42′1¼″—Weight 41,392 lb.

CASTINGS • FORGINGS • WELDLESS RINGS

• WROUGHT STEEL WHEELS •

# STANDARD

What do you look for most when choosing a speed reducer?
UNFAILING SERVICE . . .
LONG LIFE . . .
ALL AROUND ECONOMY
UNIT 1056
PHILADELPHIA GEAR WORKS

**Get all three** *by specifying* **Philadelphia Worm Gear Units**

For years industry has recognized the superiority of Philadelphia Worm Gear Units for transmitting maximum input power with minimum loss and lowest operating and upkeep costs. They're built in both horizontal and vertical types . . . in a complete range of horsepowers and ratios to meet all requirements. Write now for catalog with full descriptions and engineering data.

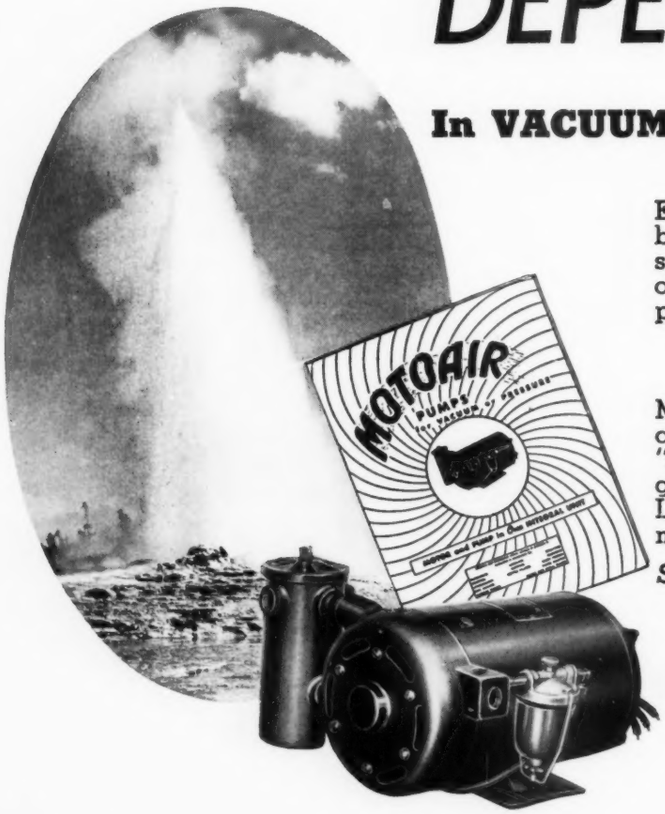
**PHILADELPHIA GEAR WORKS**

*Industrial Gears and Speed Reducers*

Erie Ave. and G St., Philadelphia, Pa.

# DEPENDABILITY

## In VACUUM and PRESSURE PUMPS!




Even Old Faithful itself is not more dependable than Motoair! For enduring, economical service, as an independent unit, or as a part of some machine which requires vacuum or pressure, there is assurance of satisfaction in

**MOTOAIR**

Mount it in any position, its visible automatic oiling system functions perfectly, without "spraying." It eliminates pulsation, and gives more air at a given electrical input. Less parts to wear—more virtues to recommend its use!

*Send for detailed, illustrated catalog*

**MOTOAIR DIVISION**

**NEW JERSEY MACHINE CORPORATION**

**HOBOKEN, N. J.**

## MAY BE TOO LATE!

IT'S too late to discover that an important spring in your product has gone bad—*after* the product is on the market. Then complaints start—complaints that can cut deep into your good will—and the products begin their ceaseless trek back to you!

Don't take needless chances. Specify Peck Springs—made by operators who know wire and understand spring design. To get more closely acquainted with "Peck Service," send for the

**FREE PECK SPRING BOOK**

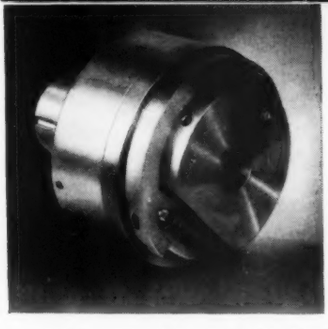
and also special technical spring data for your engineers and designers. Please write on your letter head.

# PECK SPRINGS

**AND SCREW MACHINE PARTS**

**The Peck Spring Co., 14 Summit St. Plainville, Conn.**

# HILLIARD CLUTCHES



## THE HILLIARD SINGLE REVOLUTION CLUTCH

This is an automatic clutch for intermittent and positive drive. It is especially valuable for cutting or punching operations, packaging machinery and similar applications where extremely accurate control is necessary.

Actuated by a simple trip, the Hilliard Single Revolution Clutch is suitable for mechanical, electrical or manual control. It can be set to operate on each revolution if desired or to run any number of revolutions between engagement or release.

**Write for booklet giving complete information**

***There's a Hilliard Clutch for Every Job***

OVER-RUNNING . . FRICTION . . SINGLE REVOLUTION . . SLIP . . SPECIAL

**THE HILLIARD CORPORATION**
**101 WEST 4TH ST. ELMIRA, N. Y.**

CHICAGO OFFICE: 201 N. WELLS STREET

# You've never seen a Limit Switch like SNAP-LOCK

TRADE MARK

National Acme Chronolog engineers designed and perfected Snap-Lock to insure limit switch efficiency on the hundreds of fast automatic machines that go into the plants of our customers. Out of necessity—they built a switch with machine tool ruggedness—mechanically and electrically—and proved it.

*FOR USE ON ALL NORMAL CIRCUITS*

After underwriter's approval, we offered Snap-Lock for trial to other manufacturers—machine tools, rubber, glass, steel, paper—more than 30 industries. We told them to "give it the works" at our risk.

***RESULT?*** Within one year more than 200 firms have adopted Snap-Lock as "standard" for initial equipment and maintenance requirements. Now, with adequate stock to cover specific application, we say to you—

## TEST IT YOURSELF *AT OUR RISK!*

Here's how: Bulletin 3904 brings you the seven points of Snap-Lock superiority and shows various mountings and dimensions. It contains a free trial order card. Just specify the application you want, we will ship, you "give it the works" How can you lose?

THE NATIONAL ACME CO. • Cleveland, Ohio
Please send SNAP-LOCK Bulletin 3904
Firm
Address
City
Attention of

# NATIONAL ACME

*170 East 131st Street • Cleveland, Ohio*

**BUILDERS OF ACME-GRIDLEY AUTOMATICS**
**CHRONOLOG • SOLENOIDS, LIMIT SWITCHES**

# As GRIPPING as a movie thriller!

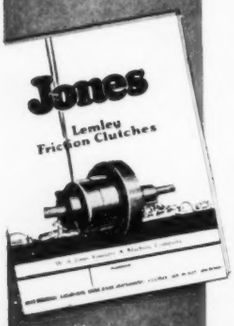
## Jones-Lemley Friction Clutches

WHEN you want a clutch you want one that takes hold with a death grip and yet eases into the load with the smoothness of a stream-lined Zephyr.

Jones-Lemley friction clutches come right up to these specifications. In addition they have attractive lines plus that sturdy "stand-up-and-take-it" design that is a feature of every Jones transmission product.

These clutches are built in a broad range of shaft sizes and ratings in both enclosed and open types for sleeve and coupling work. In addition they are available in a line of Jones-Lemley friction clutch pulleys in diameters from 12 inches to 48 inches in face widths up to 24 inches. This clutch modification is also used for gears, V-belt sheaves, sprocket wheels, etc.

The Jones engineering department has had a broad background of experience in handling all types of clutch applications. They will be glad to offer suggestions on any clutch problem you may have.




**COMPLETE CLUTCH INFORMATION**

Sizes, ratings, dimensions, prices and other data are contained in Bulletin No. 50 covering Jones-Lemley friction clutches and clutch pulleys.

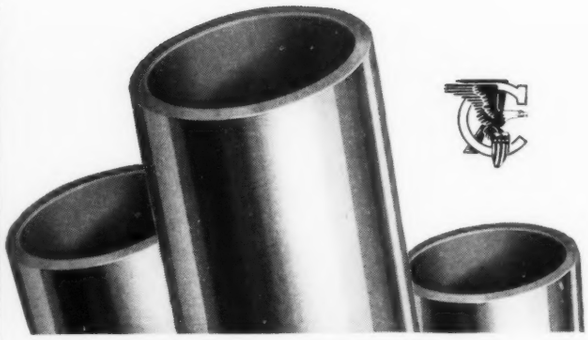
**WRITE FOR YOUR COPY**

W. A. JONES FOUNDRY & MACHINE CO.
4417 Roosevelt Road, Chicago, Illinois

*Since 1890*

# Jones

HERRINGBONE — WORM — SPUR — GEAR SPEED REDUCERS
CUT AND MOLDED TOOTH GEARS — V-BELT SHEAVES
ANTI-FRICTION PILLOW BLOCKS — PULLEYS
FRICTION CLUTCHES AND TRANSMISSION APPLIANCES



# How to Save on Stainless Tubing

If you are holding back because of stainless tubing costs—or if you are using stainless tubing now and want to spend less—here's a suggestion. • You can have the corrosion resistance, strength, and sales appeal you want and still save 15% to 40% by using Carpenter Welded Stainless Tubing. You save by lower first costs, the ability to use lighter gauges, and the more resistant surfaces found in Stainless Tubing from cold rolled strip. • And when it's made by Carpenter, the largest, most experienced manufacturer of Welded Stainless Tubing, you can forget about failures due to welding. Time-proven fabrication methods make such failures past history. • Ask Carpenter's metallurgists to show you why and how much can be saved with Carpenter Welded Stainless Tubing.

*These shapes available from distributor's stocks in 21 wholesale centers.*

New Folder shows where and how to save 15% to 40% with Welded Stainless Tubing. Gives sizes and gauges available.

**WRITE TODAY FOR YOUR COPY**

**THE *Carpenter* STEEL CO.**
WELDED ALLOY TUBE DIVISION
KENILWORTH, NEW JERSEY

# . . . "What's New With *Linde* Today?"

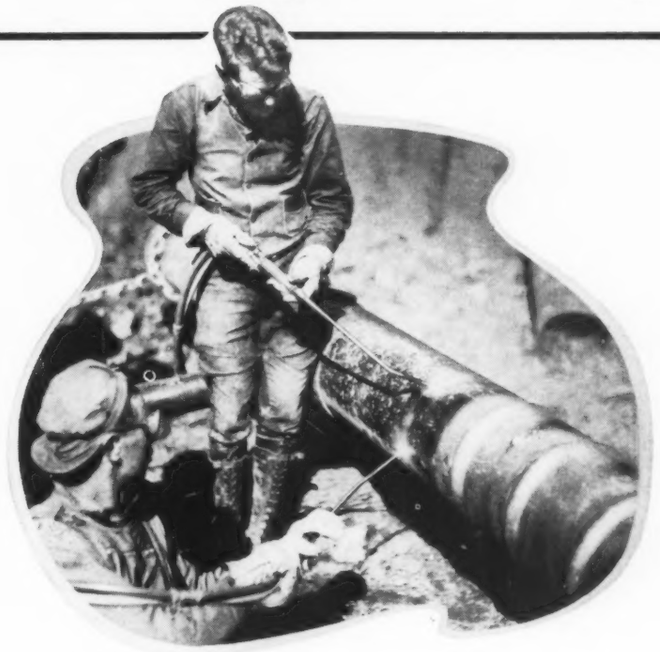
LINDE'S widespread reputation for progressiveness is one of the many reasons why Linde representatives find a "welcome mat" on the doorstep of every type of industry. Frequently, the greeting accorded the Linde man who walks in is, "What's new with Linde today?"

For metalworking men have learned that usually Linde *does* have something new — some new process, or new piece of equipment, or a new application to help do a job better or quicker, or at less cost.

Yet the most vital factor in Linde's relations with industry is not new at all—and that is the established ability to help customers use Linde products effectively.

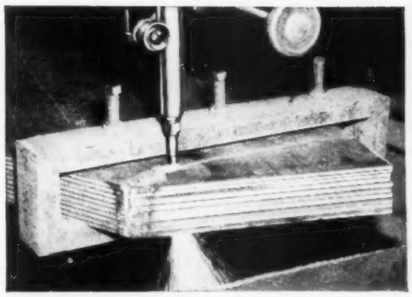
For many years, Linde Process Service has brought to Linde customers—large and small—the cumulative field experience and process data of a capable engineering staff which is integrated with a well-developed research organization.

The Linde man who calls on you will gladly point out why customers feel this service is as important to them as the high quality and fair price of all Linde products. The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation. Offices in principal cities.



**WRINKLE-BENDING**—an oxy-acetylene process for bending pipe. This process makes smooth, easy bends without stressing the pipe, thinning the wall, or offering any internal obstruction to flow. It can be used on any size pipe—light or heavy wall—requires no heavy equipment, and can be performed quickly and economically. Linde men can show you how to do it.

## *THERE IS MORE TO Linde THAN "EVERYTHING FOR WELDING AND CUTTING"*



STACK-CUTTING — an oxy-acetylene process used more and more for quantity production of shaped parts. It is fast, easy, and economical when you know how and have good equipment. Linde can supply both.

GOUGING—a fast means of removing surface metal without harm to adjacent areas. Used in removal of defective or temporary welds and for correction of design on castings or heavy structural members.

HEAVY HEATING—The Oxweld W-26 Blowpipe was developed to throw a terrific amount of heat. It can be used effectively for hundreds of forging, forming, straightening, bending or pressing operations.

**LINDE OXYGEN • NITROGEN • HYDROGEN • RARE GASES AND MIXTURES • UNION CARBIDE PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES • UNIONMELT WELDING**

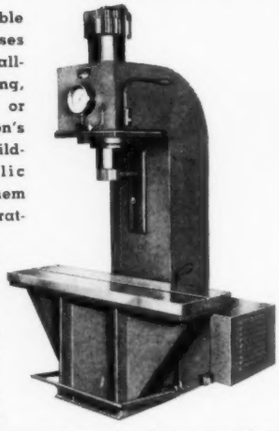
The words "Linde," "Union," "Prest-O-Lite," "Oxweld" and "Unionmelt" are trade-marks of Units of Union Carbide and Carbon Corporation.

THE STRAIGHT ROUTE
TO
GOOD SPRINGS
Whatever your spring requirements, whether for flat, coil or special types, from steel, brass, bronze, or alloys, you'll find Gibson Springs outstanding in all respects. Only a large, well-equipped plant can produce such quality springs at regular prices. Let Gibson quote on your next order.
Send your specifications to
WILLIAM D. GIBSON CO.
DIVISION OF ASSOCIATED SPRING CORP. 1800 CLYBOURN AVE., CHICAGO, ILL.
SPRINGS . WIRE FORMS . SMALL STAMPINGS
GIBSON-SPRINGS

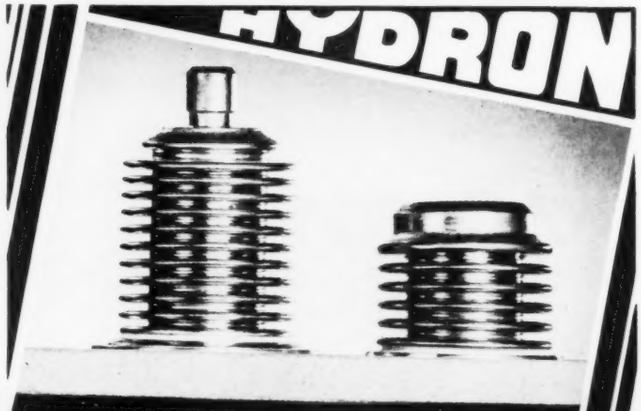
LET DENISON HELP SOLVE YOUR SPECIAL MACHINERY PROBLEMS!

A NEW LINE OF HYDRAULIC PRESSES FOR
ECONOMICAL ACCURACY
ON YOUR BROACHING, STRAIGHTENING ASSEMBLING, OR OTHER PRESS JOBS

A rugged, dependable series of hydraulic presses at *low cost* — for small-capacity straightening, assembling, broaching or other press jobs. Denison's long experience in building special hydraulic presses has enabled them to build maximum operating efficiency into this new standard-type series. 5 to 50-ton working capacities; 26" stroke; 29" maximum vertical opening. They're compact, complete; only power connections and oil for reservoir are required to put presses into operation. You'll want details on these money saving presses. Write for specification bulletins.



DENISON
*Engineering Company*
107 WEST CHESTNUT STREET COLUMBUS, OHIO




WRITE FOR 44 PAGE ENGINEER'S DATA BOOK

*Metallic Bellows*

Shaft seals and automatic pressure controls for oil-burner-pump equipment

HYDRON Metallic Bellows are used as control elements in temperature-and-pressure-control devices, and for liquid or gas seals of compressors and pumps. We are specialists in the design and production of complete thermostatic and pressure units for temperature and pressure controls. We are, therefore, prepared to extend the fullest co-operation to engineering departments of control manufacturers in the solution of design and engineering problems.

CLIFFORD MANUFACTURING CO.
564 E. FIRST STREET, BOSTON
BOSTON CHICAGO DETROIT LOS ANGELES
PRODUCERS OF BELLOWS EXCLUSIVELY
SERVING AUTOMATIC CONTROL MANUFACTURERS

# HOLD STRONGLY TOGETHER

*"HOLD STRONGLY TOGETHER"* is an Allen slogan with far-reaching implications, today.

In a restricted sense it refers to the function of Allen screws, — holding machine-parts together, more strongly than ever. It implies a necessary condition to *uninterrupted production.*

In a larger sense, "HOLD STRONGLY TOGETHER" applies to all manufacturing organization and to industrial polices. To cooperation between Management and Labor. To economic solidarity.

In its broadest sense it is a slogan of national UNITY, — for to national unity we all contribute by *"holding together".*

★ ★ ★

The Allen screw, in a great machine is relatively a little thing. But in service it worthily exemplifies the Big Thing.

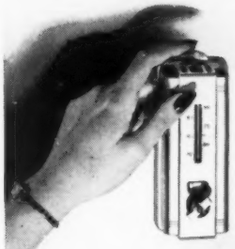
*Your local Allen Distributor provides prompt, accommodating service.*

## THE ALLEN MANUFACTURING COMPANY

HARTFORD, CONNECTICUT, U. S. A.



# A THERMOSTAT CALLS FOR HEAT



**. . . and countless**

## SYLPHON BELLOWS

**go to work**

Sylphon SEAMLESS METAL BELLOWS

• in the thermostat itself • in many packless automatic radiator valves and zone control valves • in thermostatic traps and vent valves • in combustion-regulating, indicating and recording instruments • in packless expansion joints for heating risers • in pressure regulators, etc., etc.

. . . to make possible the modern heating and air-conditioning of a great building.

In this field as in many others, the Sylphon Bellows has played so vital a part in equipment design that many devices literally owe their existence to this seamless, jointless "miracle in metal."

Improve your products. Redesign to use Sylphon Bellows for greater dependability. Consult with Sylphon engineers. And write for Bulletin XP-511.

**The Fulton Sylphon Co.**

KNOXVILLE, TENNESSEE

***Representatives in all Principal Cities in U. S. A. and in Montreal, Canada and London, England***



# ERIE INJECTION MOLDED PLASTICS

**Fulfill Expectations as well as Specifications**

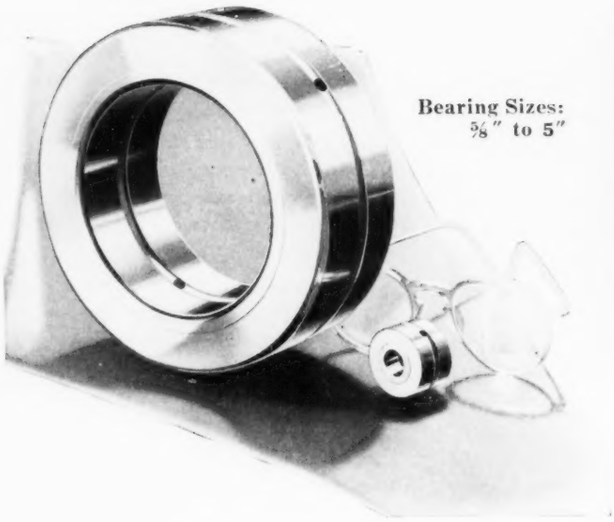
When you write the specifications for your molded parts you have certain definite expectations that you want fulfilled. Unfortunately, in many cases it's possible to meet every one of your written requirements, yet the finished product may not quite measure up to your preconceived ideas.

Here at Erie Resistor, you will find all the necessary mechanical equipment required to produce good, first-class injection molded jobs. In addition, there are engineers and production men that have grown up with injection molding. They know all the "tricks of the trade," and from past experience can take full advantage of the many opportunities offered by this method of molding. These men, in designing and supervising the construction of dies, selecting the proper molding material, setting up the dies for actual operation, finishing and inspecting the completed pieces, make the difference between an outstanding job and one that merely meets specifications.

The illustrations at the top of the page are a few examples of Erie "plus values" that have been injection molded into a variety of products for customers all over the country. May we show you what we can do for you?

**ERIE RESISTOR CORP.** — PLASTICS DIVISION

640 W. 12TH ST., ERIE, PA.

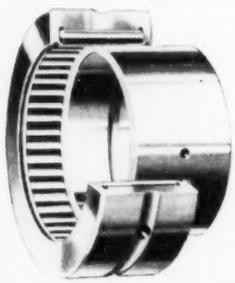


Bearing Sizes:
⅝" to 5"

# "Solidend" MULTIROL BEARINGS

## . . . made as ACCURATELY as the lenses in your glasses!

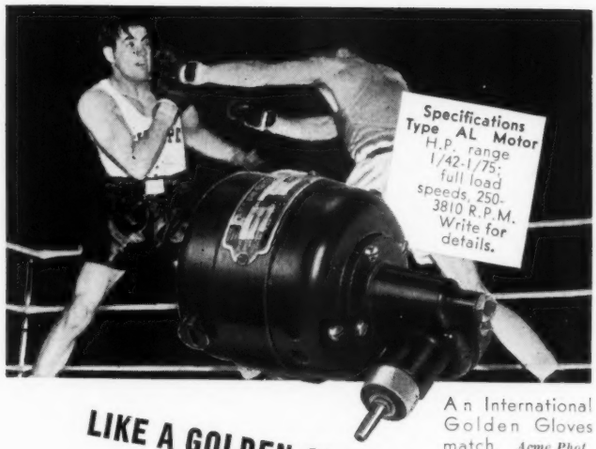
**McGILL** "Solidend" *MULTIROL* Bearings are machined with the same precision as the lenses of your glasses, and for the same reason . . . ACCURACY. Precision-machined bearings, such as the "Solidend" *MULTIROL*, provide greater load-carrying capacity, stability and longer trouble-free service. Their complete range of sizes—from ⅝" to 5"—makes them the logical choice over a wide range of applications. Roller-retaining shoulders are built integral with the outer race so that the bearing may be installed with, or without, the separable inner race, thereby eliminating the possibility of accidental dissembling.



**The perfection of the McGILL "Solidend" *MULTIROL* Bearing is a great advance in needle roller-bearing construction. Greater load-carrying capacity, simplicity of construction, rigidity, and effective sealing are secured — all at a saving in cost to the user.**

***Write for New "Solidend" MULTIROL Bulletin***

**McGILL MANUFACTURING CO.**
*Bearing Division, 750 N. Lafayette Street*
VALPARAISO, IND.




An International Golden Gloves match. *Acme Phot.*

## LIKE A GOLDEN GLOVES CHAMPION

### Dumore Gives You More for Your Money

You get out of a motor just what has gone into it. Every Dumore unit goes through the most exacting production practice known . . . proved and perfected by 25 years of experience. Small wonder that a Dumore has the guts . . . and delivers. These are the methods that give that extra punch: Armatures are dynamically balanced to eliminate vibration; leads specially swaged to assure 100% contact; commutators ground concentric with bearings for longer brush life; windings pre-expanded then double-sealed; inspected five times and run-in. 1/500th to 2/3 h.p. Tailor-made for special applications. Ask Dumore Engineers without obligation.

**THE DUMORE CO., Dept. 339-M, Racine, Wis.**

**DUMORE MOTORS**
FOR *Extra Power Hours*

# ERDLE PERFORATED METALS

*A Superior All-Purpose Product*

***FREE!***

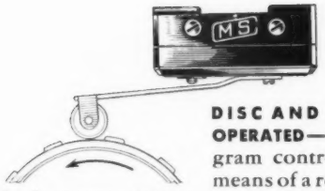
**Send for sample perforated plate. See for yourself the quality of workmanship available from Erdle—specialists for 60 years in metal perforating.**

Stock perforations or specials for any requirements available.

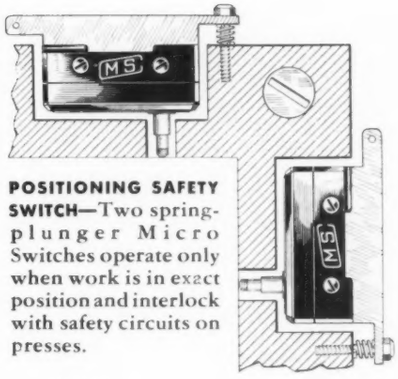
Tell us your problem. Let us show you how Erdle can help you cut costs.

Write for sample today.

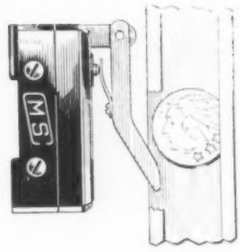
**ERDLE PERFORATING CO.**
165 York Street
Rochester N. Y.



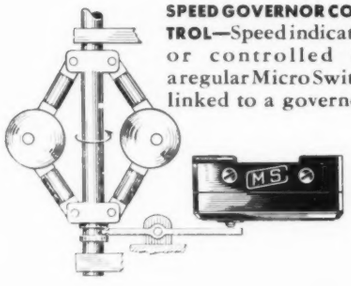
**DISC AND CAM OPERATED**— Program control by means of a roller-leaf actuator Micro Switch following strips on a driven drum.



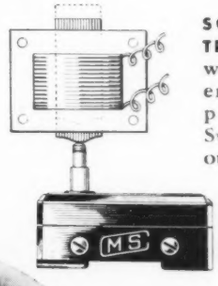
**POSITIONING SAFETY SWITCH**—Two spring-plunger Micro Switches operate only when work is in exact position and interlock with safety circuits on presses.



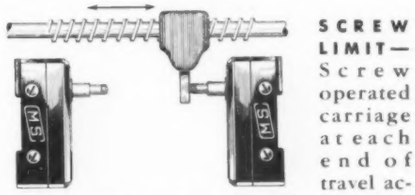
**COIN ACTUATED**—In a coin machine, the weight of a coin, through a simple lever, operates a regular sensitive Micro Switch.



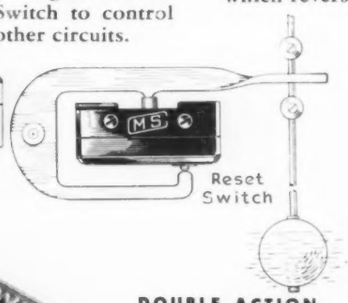
**SPEED GOVERNOR CONTROL**—Speed indicated or controlled by a regular Micro Switch linked to a governor.



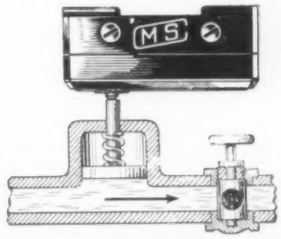
**SOLENOID CONTROL**—Solenoid when pulled in operates a spring-plunger Micro Switch to control other circuits.



**SCREW LIMIT**—Screw operated carriage at each end of travel actuates a spring-plunger Micro Switch which reverses or stops motor drive.




**DOUBLE ACTION FLOAT**—Liquid level control through the use of a reset Micro Switch and a lever operated by stops on the stem of a float.



**PRESSURE ACTUATED**— Pressure switch is made by combining a regular Micro Switch and a pressure operated plunger. The electrical circuit is thereby controlled by the opening and closing of the valve.

## If the Applications of the Micro Switch Shown Above Do Not Meet Your Design Requirements, Write Us for Complete Data

The design possibilities of this small, compact, sensitive precision snap-action switch are so broad that we cannot begin to illustrate all of them. Write for a complete set of data for your files. . . . The Micro Switch is 1 15/16″ long, weighs 1 ounce, operates precisely on small energy, small force and small movements at speeds as high as 600 times per minute and endures millions of operations. It's listed by Underwriters' Laboratories and has the approval of the Hydro-Electric Power Commission of Ontario.

## *New!* Type J Actuator Attachment for Regular and Metal-Clad Micro Switches

This actuator attachment is desirable wherever a roller-equipped pivoted arm is required. Oilless bearings throughout. Easy and simple to adjust. It is low priced and long lived. Write for data sheet No. 6 which describes it in detail.

**MICRO MS SWITCH**

*MANUFACTURED IN FREEPORT, ILLINOIS BY*

MICRO SWITCH CORPORATION

New York Chicago Boston

Copyright 1939, Micro Switch Corporation

**MICRO MS SWITCH**

# SAVINGS in CLEARANCE MATERIAL WEIGHT COST

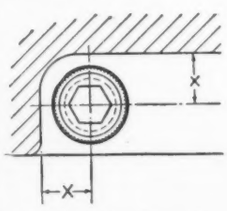
## by using... UNBRAKO

Fig. 1434 Pat's Pend.

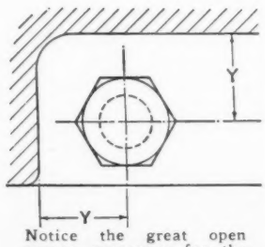
With the "Better Gripping Head"

### More Compact Designs

These plan views clearly show how close to the corner the "Unbrako" can be placed compared with the placement of ordinary screws which require setting back to allow for hex head and wrench.




See how the Knurled "Unbrako" snuggles right into the corner.




Notice the great open spaces necessary for the hex head and wrench.

### KNURLED SOCKET HEAD CAP SCREWS

Reducing flange sizes without sacrificing strength is easily accomplished by using "Unbrako" Knurled Socket Head Cap Screws. They permit a compactness of design—illustrated at the left—which means decided savings plus greater neatness. It means extra holding power too, by bringing the screw head closer to the joint.

**Write for Literature and Samples**

**STANDARD PRESSED STEEL CO.**

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JENKINTOWN, PENNA.

BOX 545

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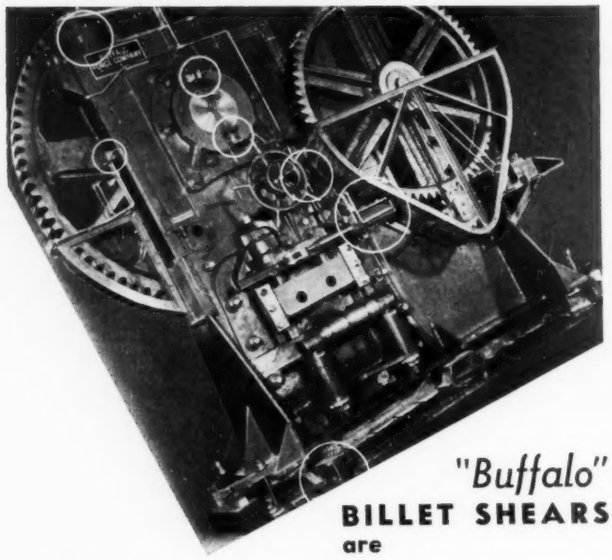


*"Buffalo"*

**BILLET SHEARS**

**are**

## T-J *Controlled . . . .*

Selecting compressed air as a control medium because of its snappy action and flexibility in application, Buffalo Forge Co. Engineers specify T-J Remote Controls. The service features incorporated in T-J Equipment insure the full advantage of air controls for smoothly functioning, perfect low cost operation.

Our Bulletin RC-4 (brand new) describes these features in detail. Write for your copy to

**THE TOMKINS–JOHNSON CO.**

**621 N. Mechanic St. Jackson, Michigan**

# Bostik

## INDUSTRIAL CEMENTS

*Eliminate Mechanical Attachments*
*Simplify Design*
*Save Assembly Labor*

For waterproof, oil and gasoline-proof, resilient bonds Bostik Neoprene-base Cements have proved themselves in a wide range of uses.

***Examples:***

For curing Neoprene to metal, Bostik M-162 and M-117 in combination give bonds above 1000 pounds per square inch.

For rubber, Neoprene and Thiokol to themselves and other materials, cold bonds with Bostik M-99 test 2 to 3 times the required strengths.

*We also make rubber-base and other types of Bostik Adhesives for Industry. Bostik may solve your problem. Write us for information.*

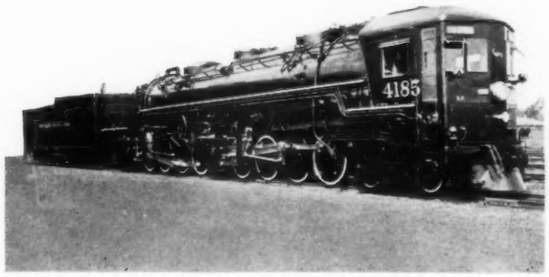
**B. B. CHEMICAL CO.**

**784 MEMORIAL DRIVE**

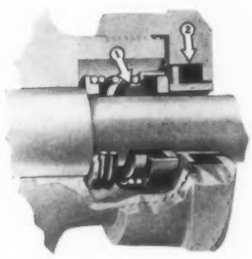
**CAMBRIDGE MASSACHUSETTS**

# THERE WERE SEALING PROBLEMS HERE

## . . . but Corprene solved each one!

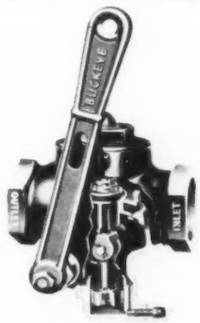


SOUTHERN PACIFIC *sure-seals the journal boxes on 50 new locomotives with inserts of Armstrong's Corprene DC-116. These reliable seals permit the use of an oil lubricant instead of the conventional grease.*



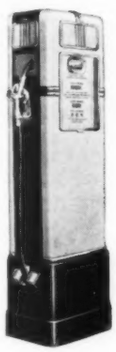
IN THIS ROTARY SEAL ASSEMBLY, *Corprene DC-130 is employed as a gasket, and as the flexible connection between the shaft and seal assembly—preventing the passage of liquid or gas along the surface, and permitting the maintenance of a perfect contact between the two radial sealing surfaces.*

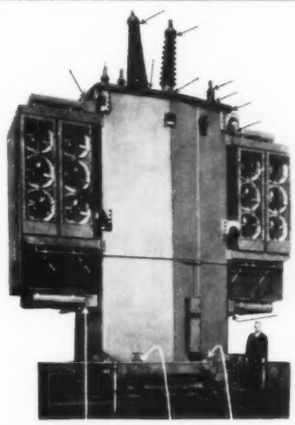
A GREASE GUN IS NO BETTER THAN ITS SEALS, *and that's why Alemite uses Armstrong's Corprene. This remarkable cork-and-synthetic-rubber composition affords a permanent, efficient seal under the most trying service conditions. These seals must be impervious to several different greases and must also withstand the wear and tear of constant assembly and dis-assembly.*




GASOLINE PROFITS CAN'T LEAK AWAY *when valve discs of Armstrong's Corprene SC-600 stand guard. This self-closing, fuel-loading valve, made by the Buckeye Iron & Brass Works, Dayton, Ohio, is permanently leak-proof even under high pressures. The two Corprene discs are impervious to oils and resist their destructive effects.*

FOR PERMANENT SIGHT GLASS SEALS, *S. F. Bowser & Co. uses gaskets of Corprene DC-100 in this "Reel-Way" pump. Since all gasoline is pumped through the sight glass, this Corprene seal must be impervious to fuels. In addition, it must be strong enough to withstand high pressures—yet sufficiently soft and resilient to prevent breakage of the glass.*





WESTINGHOUSE *uses Armstrong's Corprene DC-116 to keep the joints dry in equipment such as this huge Auto Transformer, built for the city of Los Angeles at the receiving end of Boulder Dam transmission. In oil-filled units like this, where replacement must be avoided, oil-resistant Corprene makes an ideal, permanent seal.*

### CORPRENE IS THE ANSWER to many other problems . . .

THIS BONDTRU FLEXIBLE SHAFT COUPLING, *made by the Charles Bond Company, Philadelphia, has a "spider" of Armstrong's Corprene. This "spider" (coupling insert) carries the load, prevents end-thrust and backlash, and withstands oil immersion.*

Armstrong's Corprene combines the specific advantages of cork with those of synthetic rubber. It is impervious to liquids and gases and is highly resistant to their destructive effects. It is practically unaffected by sunlight or corona. Its durability under severe conditions and its unique combination of properties, which can be "tailor-made" to fit specific requirements, make it an unusually versatile material. In addition to its many sealing applications, Corprene has special uses ranging all the way from feed rolls to airplane wing-walks.

FIND out how one or more of the 25 standard Corprene compositions can help solve your sealing problems. This remarkable cork-and-synthetic-rubber material is available in sheet, molded piece, and gasket forms. Its degree of compressibility and lateral flow, chemical and solvent resistance, coefficient of friction, hardness, tensile strength, and other properties can be controlled as desired, within narrow ranges. Write today for complete information. Armstrong Cork Co., Industrial Division, 907 Arch St., Lancaster, Pa.

ARMSTRONG'S *Corprene*

COMPOSITIONS OF CORK AND RUBBER-LIKE MATERIALS

CONTACT

CALLITE

FOR CONTACTS

The best way to *insure* flawless performance is to *make sure* you've built it in. Callite does that. Callite laboratory tests are accurate reflections of actual operating conditions. Callite electrical contacts are checked every step of the hard road to precision — checked daily. If you use contacts, it will pay you to CONTACT CALLITE.

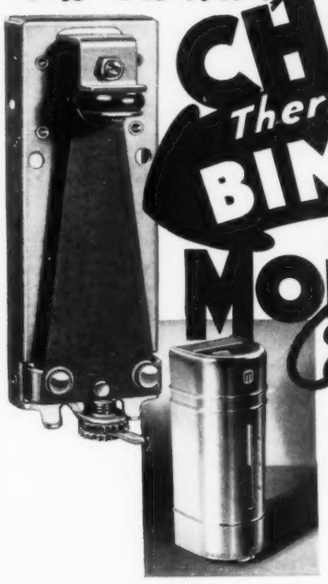
*Callite's entire staff of metallurgists and engineers are at you disposal . . . ready to bring to your particular requirements a vast fund of specialized knowledge and experience. Catalog on request.*

**CALLITE** PRODUCTS DIVISION
EISLER ELECTRIC CORP. • 550 39th ST. • UNION CITY, N. J.

*"We Are Using*

**CHACE** Thermostatic **BIMETAL**

*IN OUR* **MODERN** *Controls*



MODEL 38-T "THERMALON"
MODERN CONTROLS CO.
MILWAUKEE, WIS.

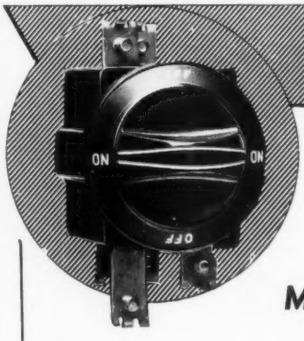
A room thermostat rich and modern in design, beautifully finished in lacquered silver plate. Standard magnetic type of snap action, using type 2400 of Chace Thermostatic Bimetal for the active element.

Regardless of the nature of your product, if you require dependable automatic movement of parts and temperature is a factor, discuss it with Chace—write us today.

**W. M. CHACE CO.**
1607 Beard Avenue - - - Detroit Mich.

if it can be improved
**HUNTER CAN DO IT!**

if it can be made
**HUNTER CAN MAKE IT!**




"DIAMOND H"

***A New Switch for Motorized Machines***

**Switches....** This switch by "Diamond H" uses a slow make and break principle which has already proved itself in other fields. It is made for AC only, and provides positive contacts, will give long service far beyond ordinary requirements. Can be installed internally or externally and made for special circuits. It is suggested for fans, blowers, and special machinery using motors up to 1 hp.

**Relays.....** "Diamond H" Relays in magnetic or Mercury tube types are providing excellent service in a great variety of uses. What is your problem?

**Thermostats.** We have advanced types of thermostats for the control of air and liquid temperatures. Suitable for electric ranges, water heaters, sterilizers, ovens, hair dryers, etc.

"Diamond H" Heat control devices are dependable.

***Send for Bulletins covering these subjects.***

**The HART MANUFACTURING CO., Hartford, Conn.**

DIAMOND H SWITCHES

# SPECIAL MOTORS

## THE HOLTZER-CABOT ELECTRIC CO.

125 Amory Street BOSTON, MASS.

CHICAGO—6161 South State St. PHILADELPHIA—112 So. 16th St. NEW YORK CITY—101 Park Ave.

## Extremely Adaptable—Reliable—Economical

This Q. A. W. valve can be operated as a 6-way, a double 3-way, or as a 4-way compound exhaust valve. The Q. A. W. line includes a type and a size for every requirement. Q. A. W. engineers are glad to assist with your pressure control problems.

*Send for Catalog and Data Book*

**C. B. HUNT & SON**

1915 EAST STATE STREET, SALEM, OHIO

# QUICK-AS-WINK

## CONTROL VALVES

6-W

THE HIGHER THE PRESSURE AIR WATER OIL THE TIGHTER THE SEAL

...units permits rearrangement to suit changes in car design.

An installation for an automobile

# PRODUCT SURVEY SHOWS A LARGE INCREASE IN THE USE OF S. S. WHITE FLEXIBLE SHAFTS

## Many New Power Drive And Remote Control Applications

The extent to which S. S. White flexible shafts have become a stand-by of designing engineers for transmitting power or for mechanical remote control, is revealed by a list of existing applications which cover a wide variety of products in many different industries.

The reason for this widespread and steadily increasing use is not hard to understand. Designing engineers often find themselves faced with the problem of providing a drive for an instrument, a pump, or some other auxiliary mechanism that is out of alignment with, or some distance away from, the source of power. An S. S. White Power Drive flexible shaft is the simple answer to the problem — a single, self-contained, easily applied unit.

Frequently also, the problem comes up of providing a means for mechanical control or adjustment of equipment from a remote point. Again an S. S. White flexible shaft is the simple solution, only for this purpose a shaft of the **Remote Control** type would be used.

The wide range of sizes and physical characteristics in which S. S. White flexible shafts are available, in both the power drive and remote control types, is another big factor in the number and variety of applications that have appeared.

From the long and varied list of applications of S. S. White flexible shafts, the following are selected as representative.

### Power Drives

**Instruments**
*Counters*
*Indicators*
*Recorders*
*Speedometers*
*Tachometers*
*Taximeters*

**General**
*Air Conditioners*
*Aircraft Fuel Pumps*
*Bottling Equipment*
*Business Machines*
*Concrete Surfacers*
*Concrete Vibrators*
*Cotton Pickers*
*Engraving Machines*
*Flame Cutting Machines*
*Food Handling Machines*
*Hair Clippers*
*Home Workshops*
*Kitchen Appliances*
*Massage Machines*
*Mechanical Toys*
*Portable Tools*
*Screw and Nut Setters*
*Shoe Machinery*
*Tube Cleaners*
*Valve Grinders*
*Washing Machines*
*Windshield Wipers*

### Remote Controls

**Automotive**
*Antenna Control*
*Carburetor Choke and Needle Valve Adjustment*
*Clock Setting*
*Crank Case Drain*
*Engine Governor Control*
*Gear Shift Control*
*Radio Receivers*
*Retractable Head Lights*
*Trip Mileage Reset*

**Aircraft**
*Antenna Reel Control*
*Beacon Receivers*
*Compass Loop Control*
*Gyro Pilot Control*
*Heating Register Control*
*Radio Receivers*
*Tab Control*
*Variable Pitch Propeller*

**General**
*Cam Position Indicator*
*Centralized Machine Controls and Adjustments*
*Electrical Switches*
*Gun Fire Controls*
*Microscope Focusing*
*Oven Thermostat Controls on Domestic Ranges*
*Valve Position Indicator*
*Washstand Drain Control*
*Weighing Balance Accurate Adjustment*

## *To* **KNOW** *Flexible Shafts is to* **USE** *them*

**Send for printed matter giving up-to-date information and engineering data on S. S. White Power Drive and Remote Control Flexible Shafts. . . . You'll find it helpful to have it handy when you design. Write for it—today.**

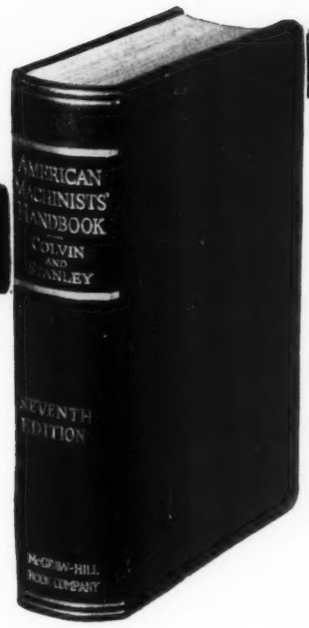
# S. S. WHITE

The S. S. White Dental Mfg. Co.
**INDUSTRIAL DIVISION**
Department D, 10 East 40th St., New York, N. Y.

# Ready
## Jan. 2, 1940

**SPECIAL OFFER**

## if you place your order NOW




**NEW 7th EDITION**

# AMERICAN MACHINISTS' HANDBOOK

## and Dictionary of Shop Terms

**By FRED. H. COLVIN**
Editor Emeritus, *American Machinist*

**and FRANK A. STANLEY**
Consulting Engineer

**1350 pages, 4 x 6½, over 2500 illustrations and tables, $4.00**

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### *A complete revision . . .*

Slightly larger in number of pages, but really greatly enlarged in usability by Colvin and Stanley's great job of revision, adding new material, simplifying and condensing standard material, weeding out obsolete data—this edition is a genuinely new tool for the machine shop of today and tomorrow.

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Why work at a disadvantage. Why run risks of breakage, waste delays, failures—when the AMERICAN MACHINISTS' HANDBOOK places right on your bench the best and latest information available on every branch of your work. Now is when to think about those times at which tough problems will come up. What will it mean to you *then* to have the right answer—the dependable one—instantly at hand? With the new 7th Edition to guide you, you'll gain satisfaction, better results, savings, at such times.

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### *Now contains 28 sections—Packed with new and revised material such as:*

—entirely rearranged, up-to-date section on screw threads
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—almost completely new section on twist drills; simplified sizes and new standards
—new section on reamers
—new data on threading dies
—new section on gear hobbing
—standard milling cutter data conveniently rearranged and condensed; new dividing heads
—new table of cutting speeds; new standard lathe spindle noses and chucks
—new grinding wheel markings; lapping and super-finishing, a new process
—new material on estimating punch press costs
—new data on broach teeth
—new instrument screw table especially valuable for fine work
—new data on optical measurements and tools
—new large "fast" tapers; new data on dovetail measurements
—new standard cross sections for drawings
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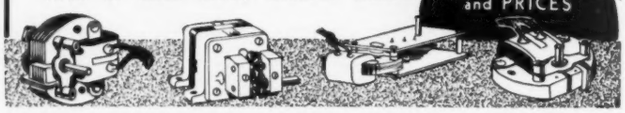

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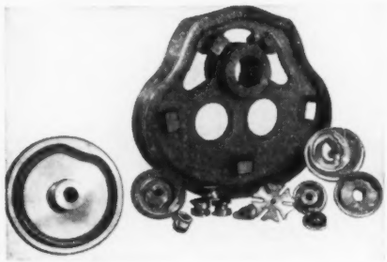

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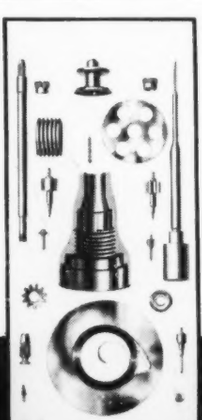

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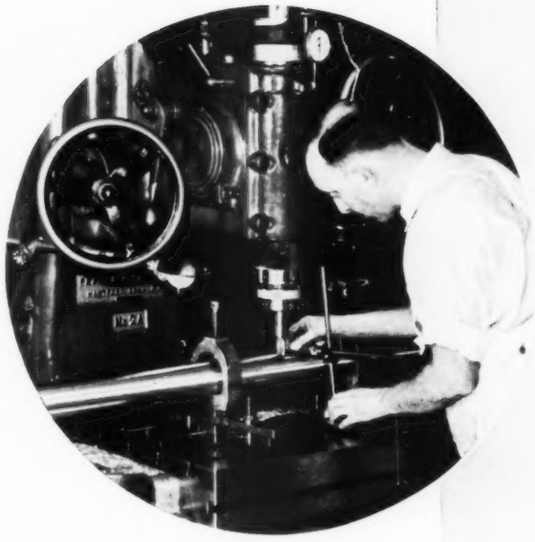

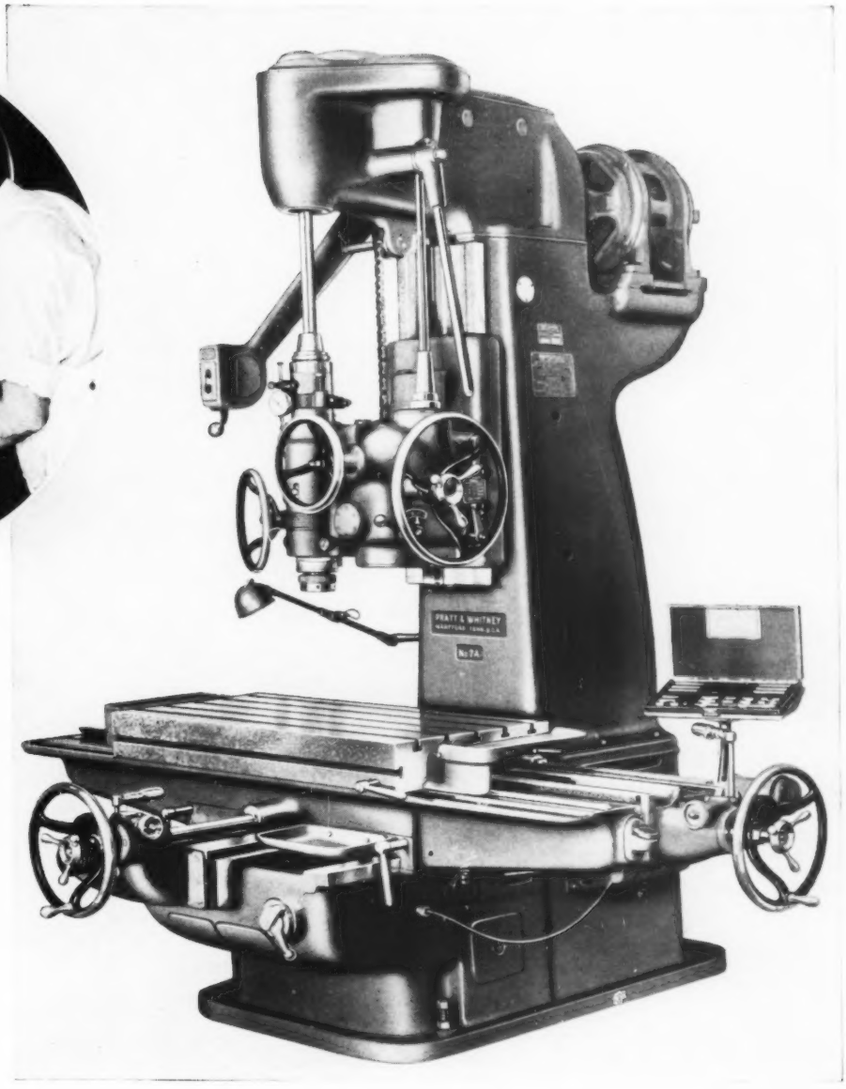

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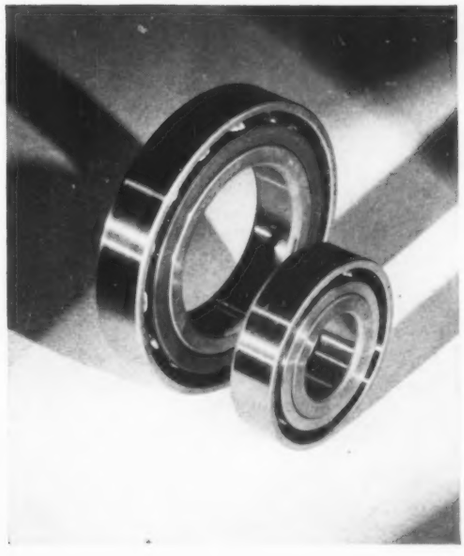

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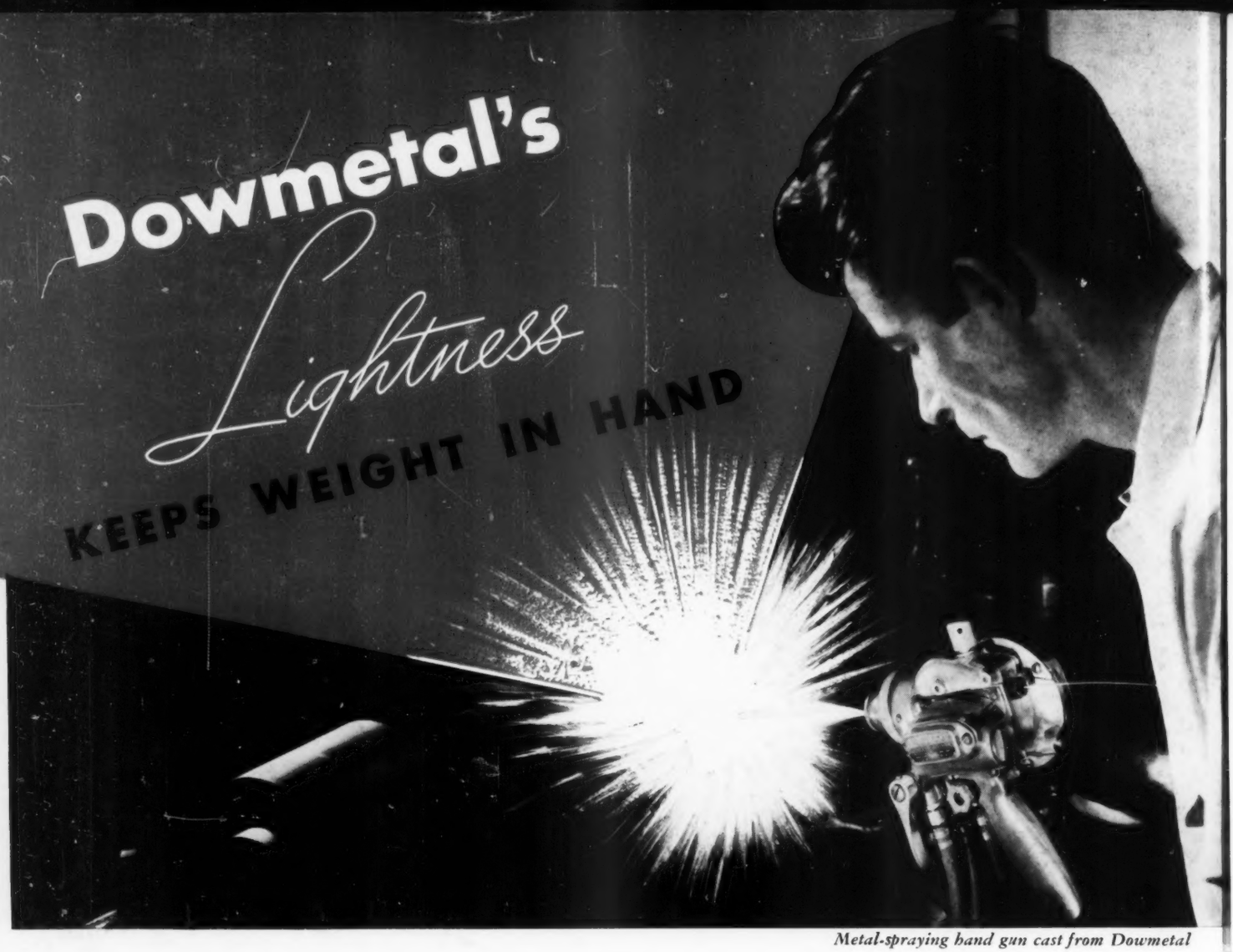

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